SCIENCE

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ELECTRIC LIGHTING BY THE KNOWLES SYSTEM.

THIS system consists of a central station containing the dynamos for the generation of the current, which is then conducted to lamp-use is obtained. It is maintained that this system is more economical, and that it allows of longer circuits, than that of direct distribution.

The system has been in operation for some time in Brooklyn,

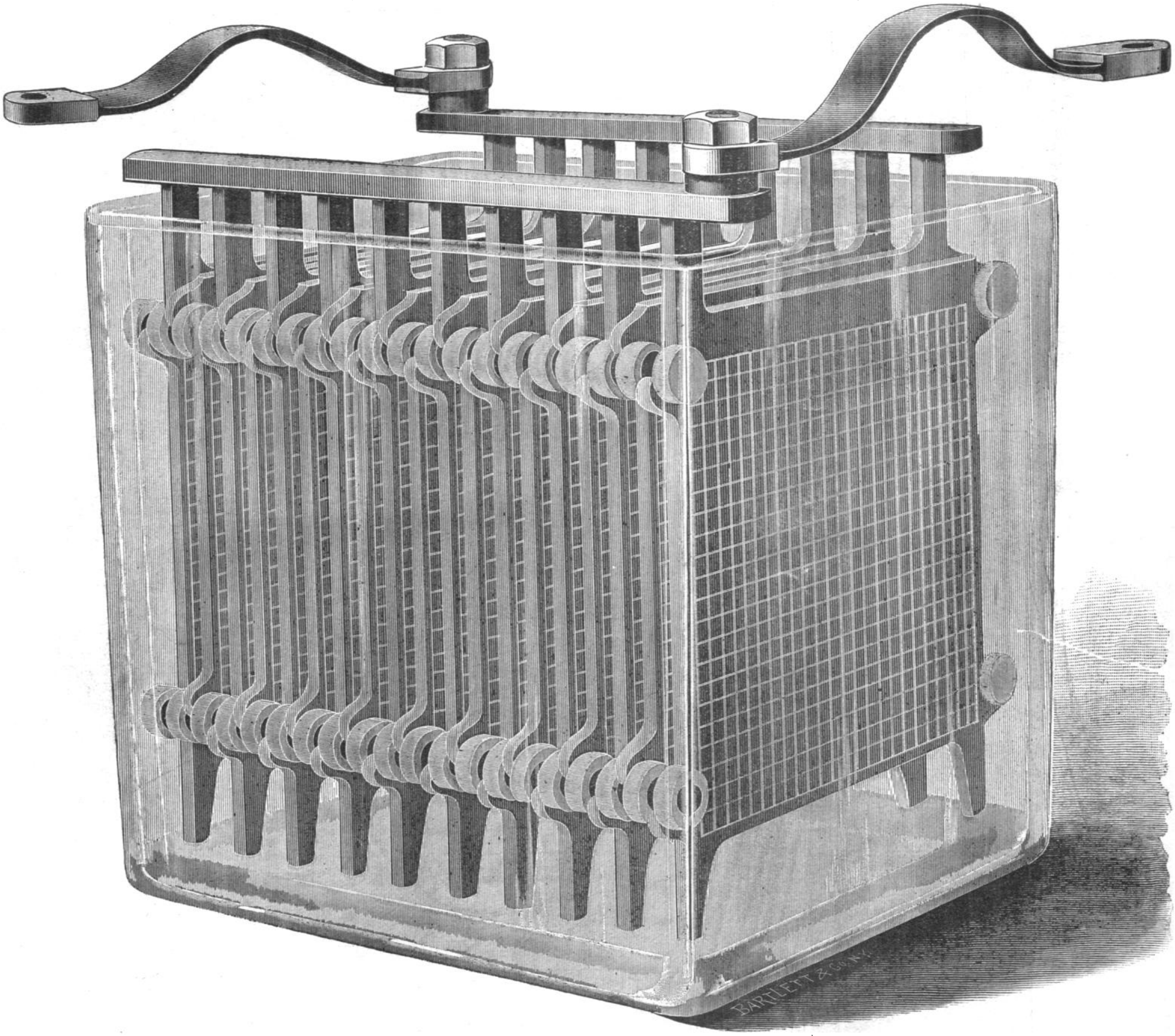

FIG. 1.—STORAGE-BATTERY OF MUTUAL ELECTRIC MANUFACTURING COMPANY, KNOWLES PATENT.

the several points at which it is to be used. At these points, instead of passing the current through the lamps, it is employed in storage-batteries; and from these storage-batteries the current for one of the battery-plants being located at 187 Montague Street, the generating-station being on Graham Street, where will be found the necessary boilers, engines, dynamos, and regulators.

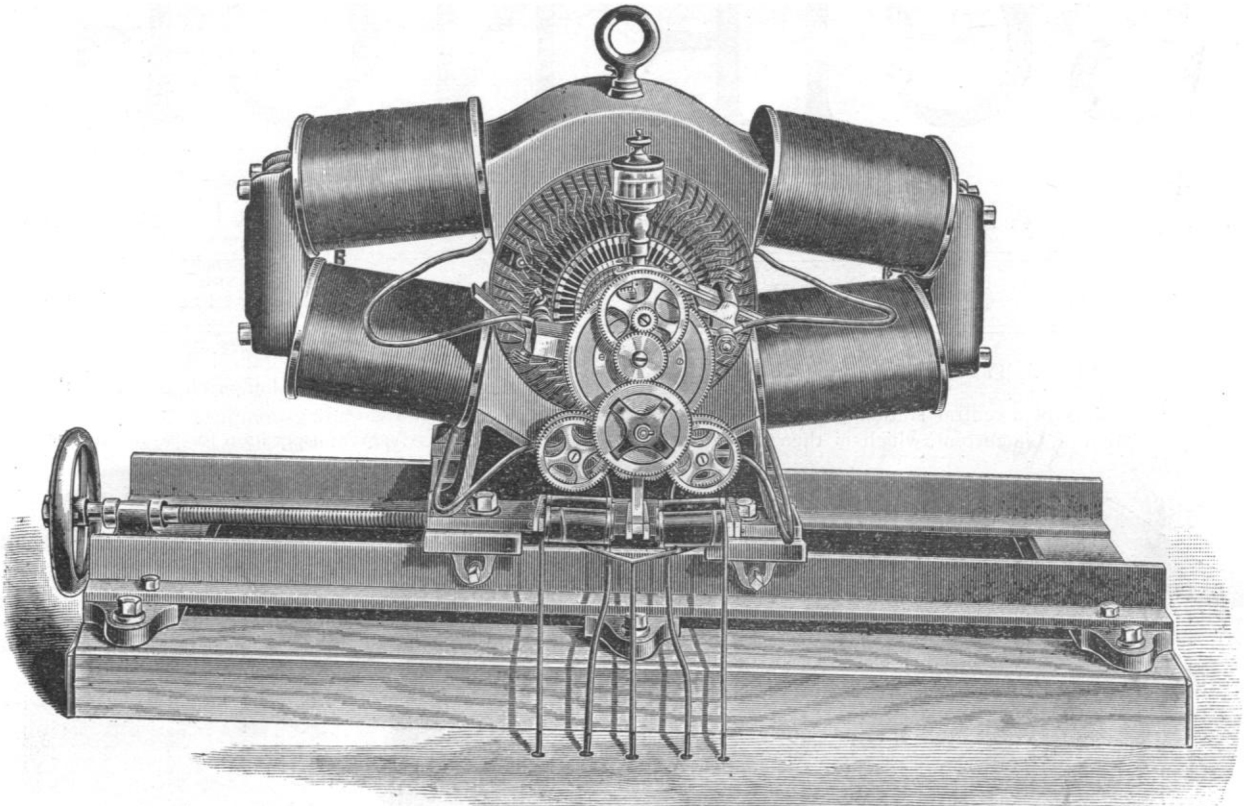

FIG. 2.—KNOWLES DYNAMO.

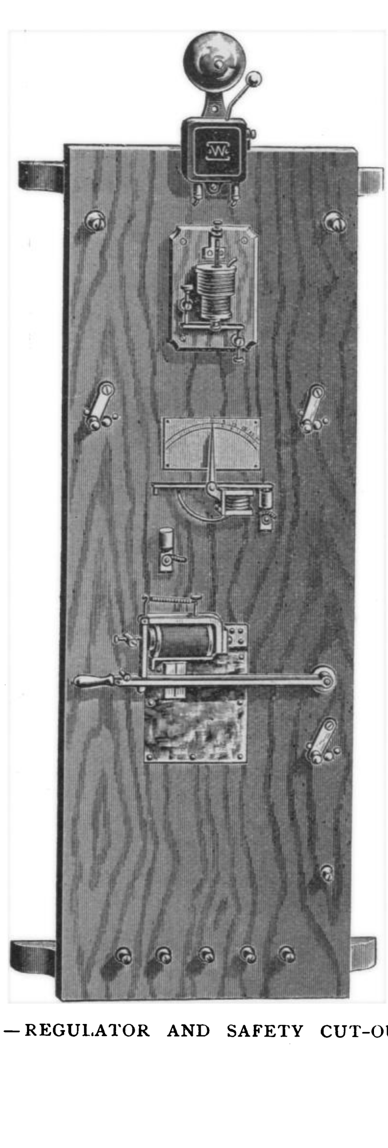

FIG. 3.—REGULATOR AND SAFETY CUT-OUT.

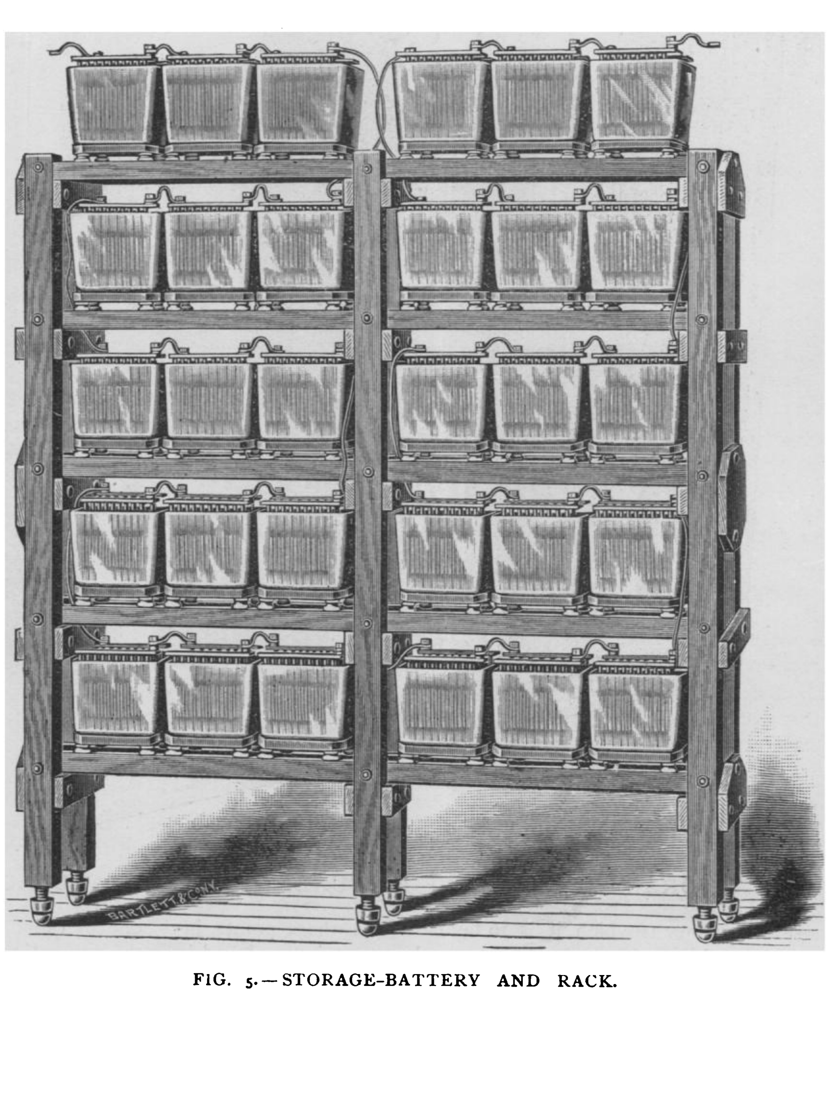

FIG. 5.—STORAGE-BATTERY AND RACK.

In charging a secondary battery from a dynamo, there is need of maintaining the charging current at a constant and suitable strength. For this purpose it will be seen in Fig. 2 that the dynamo is supplied with a clock-work arrangement, to one of the shafts of which the dynamo brushes are attached. Now, so long as the current strength is maintained, this clock-work remains

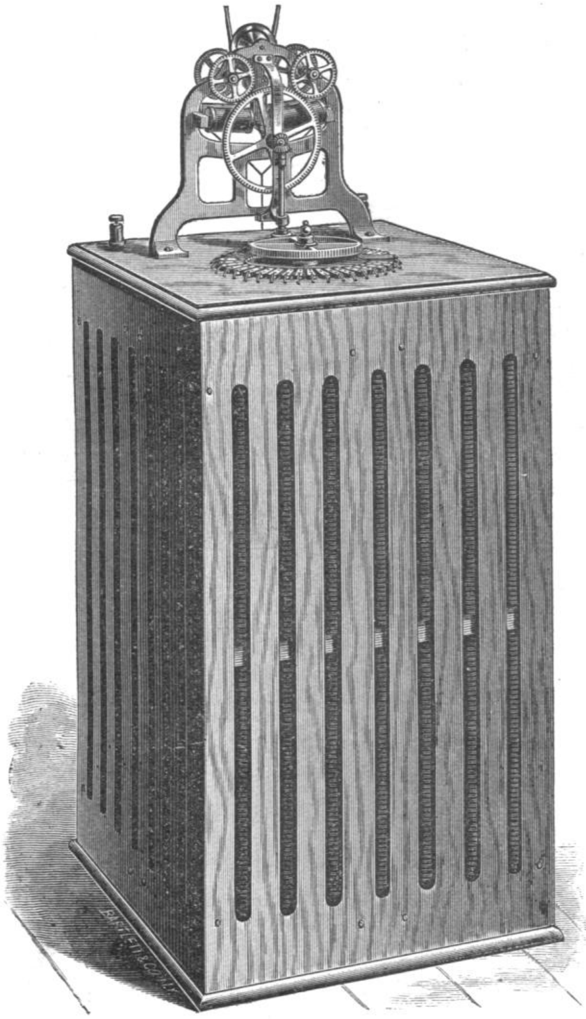

FIG. 4.—AUTOMATIC RHEOSTAT AND REGULATOR.

still; but upon any slight variation the contact-bar in the regulator (seen in the upper part of Fig. 3), consisting of a solenoid carrying a core with the contact-bar at its low end, closes a circuit passing through one or the other of the magnets of the dynamo clock-work, and causes this to move the brushes so as to increase or decrease the current, as need may be.

Again, to avoid the reversal of the polarity of the dynamo through an excessive fall in its current while charging the battery, which would allow of a reverse current passing through it from the storage-battery, the apparatus shown on the lower part of Fig. 3 is provided. On the occurrence of any sudden change, the lever shown near the bottom of the board would fall, breaking the main circuit, and causing the alarm-bell at the top to ring.

The practice of Mr. Knowles in charging is to start the dynamo on the resistances contained in the rheostat (Fig. 4), connecting the batteries when the due strength of current is reached, when, at the same time, the automatic contrivance shown on the top cuts out resistance in proportion.

The battery station in this Brooklyn plant is about half a mile from the dynamo station, but could be much farther away, it is maintained. Here the cells (Fig. 1) are arranged in batteries, as shown in Fig. 5. These racks are of wood, covered with insulating paint. Each cell rests on porcelain knobs, and the whole is again insulated from the floor.

In his secondary battery Mr. Knowles has several new features, and has avoided the application of the active material as a paste. Fig. 1 shows the cell complete. The perforated plates of non-oxidizable alloy are made in two sheets, between which is held a layer of the active material, which is moulded to the right shape before being placed between the two halves of the retaining plates. When ready, the whole is assembled as shown in the illustration, flexible insulating-rods being passed through the hooks cast on the plates top and bottom.

In a later number we hope to give further details of this system, which is being introduced by the Mutual Electric Company of Brooklyn.

DESCRIPTION OF PERRET MOTORS AND DYNAMOS.

THE chief distinctive feature of these machines, manufactured by The Elektron Manufacturing Company, Brooklyn, N.Y., is the method of constructing the field-magnet, whereby the well-known advantages due to lamination and to the best quality of iron are secured, while the cost, which has heretofore been a bar to the commercial use of such magnets, is reduced nearly to that of forgings. This method of construction is peculiarly adapted to machines of small size; and by its use their efficiency is greatly increased, as a test will show. It may also be used to advantage in machines up to 10 horse-power, and even higher; as, by the ingenious shape and arrangement of the plates, a magnet of large size may be built up of comparatively small plates, which are stamped from sheet iron, no other machine-work being necessary. Eight sizes are now on the market, and others will be soon brought out.

In the $\frac{1}{12}$, $\frac{1}{8}$, and $\frac{1}{6}$ horse-power sizes, a magnet of the ordinary U-shape is used, in which the plates are so formed and put together that the limbs may be swung apart and clamped to the face plate of a lathe for winding, after which they are swung back and bolted fast. Fig. 1 shows one of these motors complete. Fig. 2 shows the magnet before winding.

In machines of $\frac{1}{4}$ horse-power and upwards, the double horseshoe shape, with consequent poles, is used. These are shown in Fig. 3. Upon removing the two bolts which pass through the yoke, the top half of the magnet may be separated from the lower

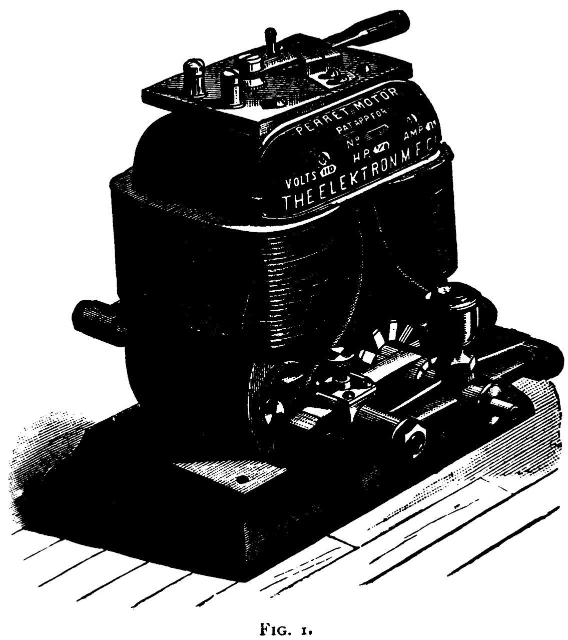

FIG. 1.

half. Each half is then attached to a lathe or other suitable machine, and wound by revolving it, after which they are put together and the bolts replaced, all these operations being very simple and very rapidly done.

One of the plates of which these magnets are built is shown in Fig. 4. Four of these are necessary to form the complete enclosure (see Fig. 5). It will be noticed that the plates interleave at the yoke, at which point their cross-section is enlarged, and they are

clamped firmly together by bolts. Little or no magnetic polarity is found at the yoke, which shows that the joint is good.

An important feature is the extremely low resistance of the magnetic circuit, which is due partly to superior quality of iron, the use of which is allowed by this construction, and partly to the smallness of the air-gap between the pole-pieces and the iron of the armature, which is of the drum type, with teeth. In the longitudinal recesses formed by these teeth the armature-coils are wound.

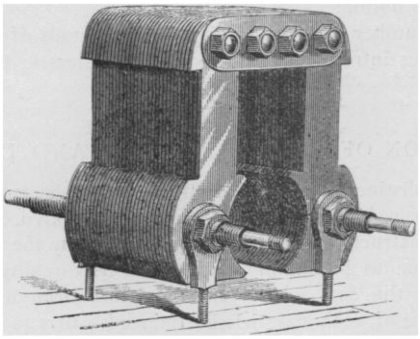

FIG. 2.

This construction increases the efficiency, allows a large reduction in armature speed, and improves the regulation. As showing this, reference is made to the ½-horse-power machine (Fig. 3), which weighs complete, with pulley, seventy pounds, and has a commercial efficiency of from 80 to 85 per cent. As a shunt-wound dynamo, it will generate a current of 4 ampères at 110 volts when run at a speed of 1,800 revolutions per minute. The armature is wound with 7,000 inches of conductor, which is at the rate of about 64 inches per volt, at the remarkably low peripheral speed of 1,500 feet per minute. This showing is believed to be rarely equalled in machines of the largest size.

It may further be stated of the ½-horse-power machine that the drop in electro-motive force when run as a dynamo, and the variation in speed as a motor, are less than 5 per cent between full load and no load (see details of Prony brake test). The motors are usually shunt-wound, and, on constant potential circuits, run at practically a constant speed, regardless of changes in load. In several instances parties requiring regulation so close that they believed compound winding absolutely necessary, have been induced to try the Perret shunt-wound machines, and have found them to fully meet the requirements.

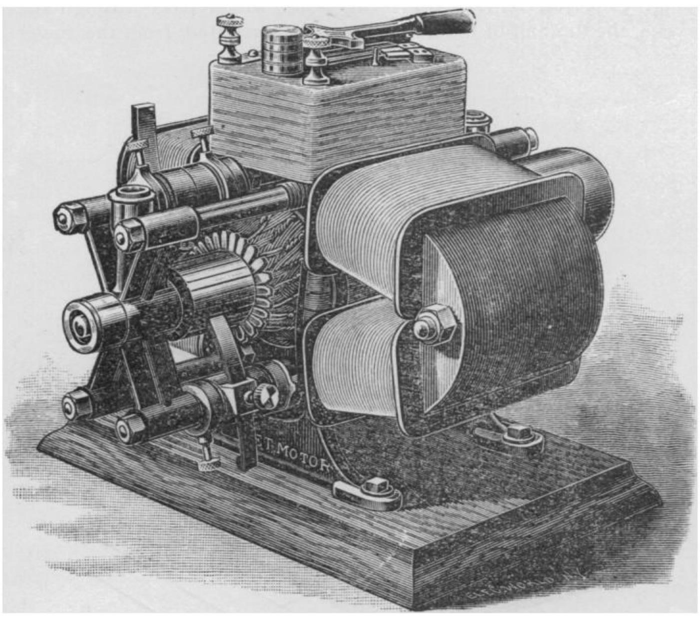

FIG. 3.

This superior regulation is due to the fact, not always given its full weight, that the regulation of a shunt-wound machine depends not only on the internal resistance of the armature-coils, but also to an equal if not larger degree on the intensity of the field: in other words, the lower the internal resistance of the armature-coils and the lower the resistance of the magnetic circuit, the closer the regulation.

This is clearly demonstrated by recent experiments with a ⅛-horse-power motor on a 110-volt circuit, which, with an armature without teeth (the air-gap being $\frac{3}{16}$ of an inch, and the internal resistance 11 ohms), showed a variation in speed of 15 per cent between no load and full load; while with an armature having teeth, by which the air-gap was reduced to $\frac{3}{32}$ of an inch, but with the internal resistance of armature increased to 20 ohms, it showed a speed variation of only 11 per cent. The same thing is shown by the performance of the ½-horse-power dynamo cited above, and also by details of the Prony brake test herewith.

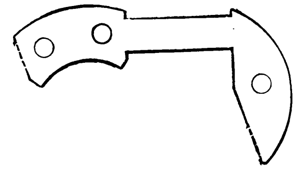

FIG. 4.

Prony Brake Test ½-Horse-Power Perret Motor.

Brake H.P.	Speed.	Commercial Efficiency.
.146	2050	.73
.185	2048	.74
.219	2046	.745
.250	2044	.76
.290	2042	.77
.320	2040	.78
.365	2035	.79
.400	2030	.80
.432	2024	.81
.467	2018	.815
.501	2010	.82
.535	2000	.80
.569	1995	.78
.600	1990	.76

It is of course not claimed that the use of toothed drum armatures is new; but Mr. Perret finds that they possess some decided advantages over plain armatures, in addition to those already stated, as, for instance, positive driving of the coils, secured by winding them in the recesses. He also finds, that, when used with finely laminated field-magnets, they are free from some disadvantages experienced in other constructions. It is quite certain that such armatures, running in close proximity to solid pole-pieces, would produce heating effects therein which would be wasteful and very troublesome, to say the least. With laminated field-magnets, all trouble of this sort is avoided.

A strong point in favor of these machines is freedom from sparking at the commutator, provided this is kept in reasonably good condition; and the brushes, having been once set at the non-sparking point, require no changing under extreme changes in load. A rocker arm for the brush-holders is therefore unnecessary, and the machine is by so much the simpler. The reason for this will be readily seen by electricians in the foregoing description, and lies in the fact that the magnetism of the field is so powerful relatively to that of the armature, that no distortion of the lines of force is produced, and consequently the line of commutation remains unchanged regardless of changes in load.

A prominent electrician connected with another motor company was heard to remark, after testing some of these machines, that they were "harder to knock a spark out of than any he had ever seen." It may be said, further, that these machines have been

worked out very perfectly in every detail, and a high degree of mechanical skill is shown in their construction.

The armature-shafts are of high-grade steel. The bearings are all accurately fitted, and are very long in proportion to their diameter, being, in the smaller sizes, of hard composition, and in the larger, of babbitt-metal. The commutators, which ordinarily are liable to great wear and damage, have received particular attention, being made of a special hard bronze. All the motors are provided with

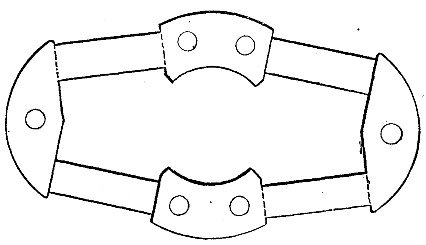

FIG. 5.

switches for starting and stopping, and in the larger sizes the switches are provided with resistance-coils, — an arrangement which is much handier than a separate rheostat.

In respect to simplicity, all parts needing attention, being in plain sight, are easily accessible. The armatures may be removed for inspection or any other purpose, and replaced in running order, in less than one minute. All parts are made to standard gauges, and are interchangeable.

CONSIDERATIONS CONCERNING SOME EXTERNAL SOURCES OF INFECTION IN THEIR BEARING ON PREVENTIVE MEDICINE.[1]

NO department of medicine has been cultivated in recent years with such zeal and with such fruitful results as that relating to the causes of infectious diseases. The most important of these results for preventive medicine and for the welfare of mankind is the knowledge that a large proportion of the causes of sickness and death are removable.

It is evident that efforts to preserve health will be most intelligently and effectually applied when they are based upon an accurate and full knowledge of the agencies which cause disease. Public and private hygiene, however, cannot wait, and fortunately has not waited, for the full light of that day, whose dawn has only begun to appear, when we shall have a clear insight into the causation of preventable diseases. Cleanliness and comfort demand that means shall be taken to render pure the ground on which we live, the air which we breathe, and the water and food with which we are supplied; and we must meet these needs without waiting to learn just what relation infectious agents bear to the earth, air, water, and food.

It is a fortunate circumstance that modern sanitation has been controlled so largely by the belief in the dependence of endemic and epidemic diseases upon organic impurities in the soil and in the water. Incomplete and even erroneous in many respects as are the views which have prevailed concerning the origin and spread of epidemic diseases by the decomposition of organic substances, the sanitary measures which have been directed toward the removal of filth have achieved great conquests in limiting the development and extension of many infectious diseases. The benefits which one commonwealth of this country has derived from the intelligent employment of public sanitary measures were clearly and forcibly presented before this association last year by Dr. Walcott, in his admirable address on State medicine.

While nothing should be said, or need be said, to lessen the importance of cleanliness for public health, it is important to bear in mind that hygienic cleanliness and æsthetic cleanliness are not identical. In water which meets the most severe chemical tests of purity, typhoid bacilli have been found. On the other hand, the air in the Berlin sewers, which certainly does not meet the most modest demands of æsthetic cleanliness, has been found to be nearly or quite free from bacteria.

It needs only to be stated to be generally admitted that the scientific basis of preventive medicine must be the accurate knowledge of the causative agents of preventable diseases, — a knowledge which can be derived only from a careful study of all of the properties of these agents, the modes of their reception and of their elimination by the body, the circumstances which favor and those which retard or prevent their development and spread, their behavior in the various substances which surround us or which we take into our bodies, and the sources of infection, not only those which laboratory experiments show to be possible, but those which are actually operative.

So long as we were unacquainted with the living organisms causing infection, the means at our disposal for studying the etiology of infectious diseases were limited to the observation of all of the circumstances which we could determine regarding the origin and spread of these diseases. We could only infer what might be the properties of the infectious agents from the study of phenomena often obscure and difficult of interpretation. Chiefly by this method of investigation the science of epidemiology has been built up. It has established facts and laws no less of practical than of scientific importance; but it has left unsolved many problems, and has filled gaps with speculations. Admitted epidemiological facts are often open to various interpretations.

We are evidently at a great advantage when we can study the epidemiological facts with a knowledge of the substances which actually cause infection, and this we are now enabled to do for a limited number of the infectious diseases. This new method of research, which thus far has been mainly bacteriological, has aided us not so much by simplifying the problems of etiology, which still remain complicated enough, as by affording greater accuracy to the results.

It is my aim in this address to consider some results of the modern studies of pathogenic micro-organisms in their bearing upon preventive medicine, more particularly upon the sources of infection. It is, of course, impossible within the limits of the address to attempt a complete survey of this important field. Time will permit the presentation of only some of the salient points.

Infectious diseases are those which are caused by the multiplication within the body of pathogenic micro-organisms.

It has always been recognized that some infectious diseases, such as the exanthematous fevers, are conveyed directly from the sick to the healthy. It is not disputed that in these evidently contagious diseases the infectious germ is discharged from the body in a state capable at once of giving rise to infection.

In a second group of infectious diseases, of which malaria is the type, the infected individual neither transmits the disease to another person, nor, so far as we know, is capable of infecting a locality. Here there is reason to believe that the infectious germ is not thrown off in a living state from the body, but is destroyed within the body. In this group the origin of infection under natural conditions is always outside of the body.

In a third group there is still dispute whether the disease can be transmitted directly from person to person, but all are agreed that the infected individual can infect a locality. It is especially fortunate that the bacteria which cause cholera and typhoid-fever, the two most important representatives of this group of so-called miasmatic contagious diseases, have been discovered and isolated in pure culture. These are the diseases about whose origin and epidemic extension there has been the greatest controversy. They, above all other diseases, have given the impulse to public sanitation during the last half-century. The degree of success with which their extension in a community is prevented is an important gauge of the excellence of the local sanitary arrangements. A clear comprehension of the origin and spread of these diseases signifies a solution of many of the most vexed and important problems of epidemiology and of State hygiene.

It is difficult to understand how those who accept the discovery that the bacteria causing typhoid-fever and cholera have been found and cultivated from the stools of patients affected with these diseases can doubt that these patients are possible sources of contagion, or can entertain the view, once so widely prevalent, that the

[1] Address in State medicine, delivered before the American Medical Association, in Newport, on Friday, June 28, by William H. Welch, M.D., professor of pathology in Johns Hopkins University, Baltimore.

infectious germs of these diseases are discharged from the body in a condition incapable of producing immediate infection. In an address delivered on another occasion, I have endeavored to present the considerations which reconcile the comparative infrequency of direct contagion for these diseases with the belief in the elimination of the causative germs in an active state from the body, and have there pointed out several well-known factors which determine the frequency of conveyance of an infectious disease by contagion. There are reasons, some of them very obvious, why diseases in which the infectious substances are operative only when received into the digestive tract, and are discharged usually only with the fæces, are less likely to be transmitted by immediate contagion than those diseases in which the virus is thrown off from the skin on epidermal scales.

But the field of operation of direct contagion for those so-called miasmatic contagious diseases is at most a restricted one, and the chief sources of infection are outside of the body from which primarily the infectious germs may have been derived. It is to these external sources of infection, which are of such importance in public hygiene, that I wish especially to direct attention.

A full comprehension of the sources of infection is, of course, to be obtained only by a detailed study of the etiology of the individual infectious diseases; but this is, of course, impossible within the limits of an address. It may, however, be useful to present some of the facts which have a general bearing upon the subject. Let us consider, then, from the point of view of modern bacteriological studies, what *rôle* in harboring or transporting infectious agents may be played by those substances or media with which we necessarily come into intimate contact, such as the air, the ground, the water, and our food.

It is universally admitted that many infectious agents may be transported by the air, but the extent of danger from this source has often been exaggerated. It is a popular error to suppose that most of the minute particles of dust in the air either are or contain living organisms. The methods for determining the number and kind of bacteria and fungi in the air are now fairly satisfactory, although by no means perfect. These have shown that while the number of living bacteria and fungi in the atmosphere in and around human habitations cannot be considered small, still it is greatly inferior to that in the ground or in most waters. Unlike fungus spores, bacteria do not seem to occur to any extent in the air as single detached particles, which would then necessarily be extremely minute, but rather in clumps or attached to particles of dust of relatively large size. As a result, in a perfectly quiet atmosphere these comparatively heavy particles which contain bacteria rapidly settle to the ground or upon underlying objects, and are easily filtered out by passing the air through porous substances, such as cotton-wool or sand. Rain washes down a large number of the bacteria from the air. That the air bacteria are derived from the ground, or objects upon it, is shown by their total absence, as a rule, from sea-air at a distance from land, this distance naturally varying with the direction and strength of the wind.

A fact of capital importance in understanding the relations of bacteria to the air, and one of great significance for preventive medicine, is the impossibility of currents of air detaching bacteria from moist surfaces. Substances containing pathogenic bacteria, as, for instance, sputum containing tubercle bacilli, or excreta holding typhoid bacilli, cannot, therefore, infect the air unless these substances first become dry and converted into a fine powder. We are able to understand why the expired breath is free from bacteria and cannot convey infection, except as little particles may be mechanically detached by acts of coughing, sneezing, or hawking. Those bacteria the vitality of which is rapidly destroyed by complete desiccation, such as those of Asiatic cholera, evidently are not likely to be transported as infectious agents by the air, if we except such occasional occurrences as their conveyance for a short distance in spray.

The only pathogenic bacteria which hitherto have been found in the air are the pus-organisms, including the streptococcus found by Prudden in a series of cases of diphtheria and tubercle bacilli; but no far-reaching conclusions can be drawn from the failure to find other infectious organisms, when we consider the imperfection of our methods, and the small number of observations directed to this point. The evidence in other ways is conclusive that many infectious agents — and here the malarial germ should be prominently mentioned — can be, and often are, conveyed by the air. While we are inclined to restrict within narrower limits than has been customary the danger of infection through the air, we must recognize that this still remains an important source of infection for many diseases. All those, however, who have worked practically with the cultivation of micro-organisms, have come to regard contact with infected substances as more dangerous than exposure to the air; and the same lesson may be learned from the methods which modern surgeons have found best adapted to prevent the infection of wounds with the cosmopolitan bacteria which cause suppuration.

We are not, of course, to suppose that infectious germs floating in the form of dust in the atmosphere are dangerous only from the possibility of our drawing them in with the breath. Such germs may be deposited on substances with which we readily come into contact, or they may fall on articles of food where they may find conditions suitable for their reproduction, which cannot occur when they are suspended in the air, in consequence of the lack of moisture.

From the facts which have been mentioned concerning the relations of bacteria to the air, what points of view present themselves to guide us in preventing infection through this channel? Surely something more than that this purpose is accomplished simply by abolishing foul odors.

Certain indications are so plain as to need only to be mentioned in this connection, such as the disinfection and removal, as far as possible, of all infected substances, — an indication which applies equally to all channels of infection, and which is much easier to mention than it is to describe how it shall be realized. But there are two indications which apply especially to the prevention of the transportation of disease-germs by the air. One is the necessity of guarding, so far as practicable, against the desiccation, when exposed to the air, of substances which contain infectious germs not destroyed by drying; and another is free ventilation.

For no disease is the importance of the first of these indications so evident and so well established as for tuberculosis, the most devastating of all infectious diseases. Against this disease, formidable as it may seem to cope with it, the courageous crusade of preventive medicine has begun, and is destined to continue.

It is now generally recognized that the principal, although not the sole, sources of tuberculous infection are the sputum of individuals affected with pulmonary tuberculosis, and the milk of tuberculous cows. Cornet, who has made a laborious and most instructive experimental study of the modes and dangers of infection from tuberculous sputum, has also elaborated the practical measures which should be adopted to diminish or annihilate those dangers. These measures have been so recently and so widely published in medical journals, and so clearly presented before a section of this association, that I mention them only to call the attention of practitioners of medicine to their importance, and to emphasize the fact that they are based chiefly upon the principle that infectious substances of such nature as tuberculous sputum should not be allowed to become dry and converted into dust when exposed to the air.

By means of free ventilation, disease-producing micro-organisms which may be present in the air of rooms are carried away, and distributed so far apart that the chance of infection from this source is removed, or reduced to a minimum. It is a well-established clinical observation that the distance through which the specific microbes of such diseases as small-pox or scarlatina are likely to be carried from the patient by the air in such concentration as to cause infection, is small, usually not more than a few feet, but increases by crowding of patients and absence of free ventilation. The well-known experiences in the prophylaxis and treatment of typhus-fever are a forcible illustration of the value of free ventilation.

It is, of course, not to be understood that by ventilation we accomplish the disinfection of a house or apartment. Ventilation is only an adjunct of such disinfection, which, as already mentioned, is of first importance. Time will not permit, nor is it in the plan

of this address, to discuss the details of such questions as house disinfection; but I may be permitted to say that the methods for disinfecting apartments have been worked out on a satisfactory experimental basis, and should be known, at least, by all public-health officers. Whether it be pertinent to this occasion or not, I cannot forbear to add my protest to that of others against placing reliance upon any method hitherto employed of disinfecting houses or apartments by fumigation; and I would furthermore call attention to the lack, in most cities of this country, of public disinfecting establishments, such as are in use with excellent results in most cities of Europe, and which are indispensable for the thorough and convenient disinfection of clothing, bedding, carpets, curtains, etc.

After this short digression, let us pass from the consideration of the air as a carrier of infection to another important external source of infection; namely, the ground. That the prevalence of many infectious diseases depends upon conditions pertaining to the soil cannot be questioned; but the nature and the extent of this influence have been and are the subjects of lively discussion. The epidemiological school led by Pettenkofer assigns, as is well known, to the ground the chief, and even a specific and indispensable, influence in the spread of many epidemic diseases, particularly cholera and typhoid-fever. The statistics, studies, and speculations of epidemiologists relating to this subject probably surpass in number and extent those concerning any other epidemiological factor. The exclusive ground-hypothesis has become an ingenious and carefully elaborated doctrine with those who believe that such diseases as cholera and typhoid-fever can never be transmitted by contagion. These authorities cling to this doctrine with a tenacity which indicates that on it depends the survival of the exclusively localistic dogma for these diseases.

To all who have not held aloof from modern bacteriological investigations it must be clear that views which have widely prevailed concerning the relations of many infectious germs to the soil require revision. The question is still a difficult and perplexing one; but on some hitherto obscure or misunderstood points these investigations have shed light, and from the same source we may expect further important contributions to a comprehension of the relations of the ground to the development of infectious diseases.

The ground, unlike the air, is the resting or the breeding place of a vast number of species of micro-organisms, including some which are pathogenic. Instead of a few bacteria or fungi in a litre, as with the air, we find in most specimens of earth thousands, and often hundreds of thousands, of micro-organisms in a cubic centimetre. Fraenkel found the virgin soil almost as rich in bacteria and fungi as that around human habitations. This vast richness in micro-organisms belongs, however, only to the superficial layers of the earth. Where the ground has not been greatly disturbed by human hands, there is, as a rule, about three to five feet below the surface an abrupt diminution in the number of living organisms; and at the depth where the subsoil water usually lies, bacteria and fungi have nearly or entirely disappeared. Fraenkel, who first observed this sudden diminution in the number of micro-organisms at a certain level beneath the surface, explains this singular fact by the formation at this level of that sticky accumulation of fine particles, consisting largely of bacteria, which forms the efficient layer in large sand-filters for water. Of course, the number of bacteria, and the depth to which they penetrate, will vary somewhat with the character, especially the porosity, of the soil, and its treatment; but the important fact that all, or nearly all, of the bacteria and fungi are retained in the ground above the level of the subsoil water, will doubtless hold true for most situations.

The conditions are not favorable for the multiplication of bacteria in the depth of the ground, as is shown by the fact that in specimens of earth brought to the surface from a depth of a few feet the bacteria which are at first present rapidly multiply. What all of the conditions are which prevent the reproduction of bacteria in the deep soil has not been ascertained, but the fact necessitates similar precautions in the bacteriological examination of the soil as in that of water.

We have but meagre information as to the kinds of bacteria present in the ground in comparison with their vast number. Many of those which have been isolated and studied in pure culture possess but little interest for us, so far as we know. To some of the micro-organisms in the soil appears to be assigned the *rôle* of reducing or of oxidizing highly organized substances to the simple forms required for the nutrition of plants. We are in the habit of considering so much the injurious bacteria, that it is pleasant to contemplate this beneficent function so essential to the preservation of life on this globe.

Among the pathogenic bacteria which have their natural home in the soil, the most widely distributed are the bacilli of malignant œdema and those of tetanus. I have found some garden-earth in Baltimore extremely rich in tetanus bacilli, so that the inoculation of animals in the laboratory with small bits of this earth rarely fails to produce tetanus. In infected localities the anthrax bacillus, and in two instances the typhoid bacillus, so far as it was possible to identify it, have been discovered in the earth. There is reason to believe that other germs infectious to human beings may have their abiding-place in the ground; certainly no one doubts that the malarial germ lives there. As the malarial germ has been shown to be an organism entirely different from the bacteria and the fungi, we cannot apply directly to its behavior in the soil, and its transportation by the air, facts which have been ascertained only for the latter species of micro-organisms; and the same precautions must be observed for other diseases with whose agents of infection we are not acquainted, as, for instance, yellow-fever.

In view of the facility with which infectious germs derived from human beings or animals may gain access to the soil, it becomes a matter of great importance to determine how far such germs find in the soil conditions favorable for their preservation or their growth. We have, as is well known, a number of epidemiological observations bearing upon this subject; but, with few exceptions, these can be variously interpreted, and it is not my purpose to discuss them. The more exact bacteriological methods can, of course, be applied only to the comparatively small number of infectious diseases, the causative germs of which have been isolated and cultivated; and these methods hitherto have been applied to this question only imperfectly. We cannot regard the soil as a definite and unvarying substance in its chemical, physical, and biological properties. What has been found true of one kind of soil may not be so of another. Moreover, we cannot in our experiments bring together all of the conditions in nature which may have a bearing on the behavior of specific micro-organisms in the soil. We must therefore be cautious in coming to positive conclusions on this point on the basis of experiments, especially those with negative result. With these cautions kept constantly in mind, the question, however, is one eminently open to experimental study.

The experiments which have thus far been made to determine the behavior of infectious micro-organisms in the ground have related especially to the bacilli of anthrax, of typhoid-fever, and of cholera; and, fortunately, these are the diseases about whose relations to the ground there has been the most discussion, and concerning which we are most eager to acquire definite information.

(*Continued on p. 78.*)

NOTES AND NEWS.

ACCORDING to the Calcutta correspondent of the London *Times*, a herd of 100 wild elephants has been captured in Mysore by Superintendent Sanderson. The same correspondent states that there were 6,000 deaths by snake-bites in the North-West Provinces last year. In Madras, 10,096 cattle were killed by wild animals, and the loss of human life by snakes and wild animals was 1,642.

— The United States Bureau of Education has issued as circular of information No. 7, 1888, in the series of contributions to American educational history, edited by Herbert B. Adams, "A History of Education in Florida," by George Gary Bush, Ph.D.

— The preparations for the Niagara Falls electrical convention, Aug. 6, 7, and 8, have been completed. The convention will be welcomed to Niagara Falls by the Hon. W. C. Ely, who, in his salutatory address, will touch upon the utilization of water-power for electric-light purposes. President E. R. Weeks will open the convention with an address, including among other things a statistical

account of the present state of the electric light and power industries. The executive committee will report through its chairman, Mr. Benjamin Rhodes, who will record the general work of the association for the last six months, and more particularly that portion of it not fully covered in the other committee and official reports. This will be followed by the usual report of the secretary and treasurer. The committee on harmonizing the electric-light and insurance interests will report through its chairman, Mr. P. H. Alexander, who will present elaborate statistics on the fire losses collected and the insurance premiums paid by electric-light companies; the committee will also recommend measures by which insurance rates on electric-light stations may be lowered. The national committee on State and municipal legislation will report through its chairman, Mr. Allan R. Foote of Cincinnati. This committee, which is now composed of twenty-six gentlemen from as many different States, and whose object was set forth in Bulletin No. 1 of the National Electric Light Association of New York, is now fully organized and ready for work. The committee on the revision of the constitution will report through its chairman, Dr. Otto A. Moses, who will submit a carefully considered revision of the present constitution. Dr. Moses will also address the convention on the recent movement in New York State to introduce killing by electricity as a substitute for hanging in legal execution. He will supplement his remarks with well-digested statistics. The following papers will be read: "The Value of Economic Data to the Electric Industry," by Mr. Allan R. Foote of Cincinnati; "Electric Street-Railways," by Mr. George W. Mansfield of Boston; "An Ideal Station," a paper in two parts, — from an electrical standpoint, by Mr. Marsden J. Perry of Providence; from a mechanical standpoint, by Mr. John T. Henthorn of the same city; "The Economic Size of Line-Wire," by Benjamin Rhodes of Niagara Falls; "Station Accessories in the Shape of Measuring-Instruments," by C. C. Haskins of Chicago; "The Development and Progress of the Storage-Battery," by Mr. William Bracken of New York; "The Theoretically Perfect Arc-Light Station," by M. M. D. Law of Philadelphia; and "The Electrical Transmission of Power," by Professor E. P. Roberts of Cleveland. Mr. A. J. De Camp will address the convention on "The Methods of Arriving at the Cost of the Products of a Station." Gentlemen who propose attending the Niagara Falls convention are reminded, that, to get the two-thirds rebate on their return railroad-ticket, it will be necessary for them to procure a Trunk Line or Central Traffic Association certificate from the ticket-agent when they buy their ticket to Niagara Falls. The secretary and treasurer, Allan V. Garratt, will be at the Electric Club Saturday and Sunday evenings, Aug. 3 and 4, and at the Erie Railroad Depot, at the foot of Chambers Street, New York, at 8.45 o'clock A.M., Monday, Aug. 5, to supply tickets and certificates for the special train at 9 o'clock A.M. on the same day.

— Mr. D. W. Langdon, jun., who has been for a number of years connected with the Alabama Geological Survey, has entered upon the duties of geologist and consulting mining engineer of the Chesapeake and Ohio Railway, probably with headquarters at Richmond, Va.

— Professor G. E. Morrow of the University of Illinois is now in Europe, in behalf of the United States Department of Agriculture, to make a report on the live-stock exhibited at the Royal Agricultural Society show at Windsor. He will also visit the Continent, and especially France and Germany.

— On July 15 a deep-sea exploration party started from Kiel, on board the steamer "National," for the Greenland coast, where they propose to carry on a series of submarine soundings and investigations. The expedition is directed by Professor Hensen.

— The next international archæological congress is to be held in Christiania in 1891. It was originally intended that it should be held in London. Dr. Ingvald Undseth of Christiania is the general secretary.

— According to a correspondent of the *Artisan*, a simple plan of preventing sheet-iron stacks from rusting is as follows: if before raising the new chimney, each section, as it comes from the shop, be coated with common coal-tar, then filled with light shavings and fired, it will resist rust for an indefinite period, rendering future painting unnecessary. In proof of this, he cites a chimney which was erected in 1866, treated as above described, and is to-day as bright as it was the day it was raised, without having a particle of paint applied since. The theory by which he accounts for this result is that the coal-tar is literally burned into the iron, closing the pores, and rendering it rust-proof.

— In the *Engineering and Mining Journal* for July 27, Henry Wurtz maintains that asphalts and asphaltoids are mainly produced from rock-oils by polymerization of certain constituents of such oils under the influence of the air, or of the sun's rays, or of both, together with the influence of acid, saline, or other polymerizing agents incidentally present; and the author defines polymerization as due to and dependent on the coalescence of two or more molecules of an element or compound into one; being inclusive and explanatory, as thus regarded, of the allotropism of Berzelius.

— From some notes on the color of the eyes and hair in Norway, by Drs. Abbo and Faye, with tables and annotations by M. Topinard, in the *Revue d'Anthropologie*, it appears that the population of Norway exhibits a higher percentage (97.25) of light eyes than any other country in Europe. Flaxen hair occurs in 57.5 per cent of the people of the northern provinces; and, while absolutely black hair is found only in the ratio of 2 per cent, red hair does not rise higher than 1.5 per cent in the scale of hair-coloration.

— *Nature* gives the following summary of a paper on "Hallstatt in Austria, its Places of Burial, and its Civilization," by Dr. Hornes: "This is an extremely interesting summary of the important discoveries made within the last few years in the Hallstattian burying-grounds of Slavonian Austria, more especially at Watsch in Carniola, where the beauty and finish of the carved baldrics and belts have led contemporary paleontologists to regard them as an evidence of the existence in central Europe of an early civilization, which had already attained to considerable artistic culture before its extinction under the weight of advancing hordes of barbarian invaders. The necropolis of Hallstatt, for our acquaintance with which we are indebted to Baron Sacken, still remains unrivalled for the splendor and variety of its antiquities, notwithstanding the marvellous results of the recent Carniolian and Croatian finds. Between 1846 and 1863, Sacken and Ramsäuer published reports of their explorations of nearly 1,000 tombs, while since that period the number of graves explored has risen to nearly 1,900. Both at Hallstatt and Watsch the rites of interment and incineration had been followed with nearly equal frequency; but, although in the case of the latter the graves appear to have been most richly supplied with gold ornaments and carved bronze arms, the abundance of yellow amber and of decorative objects of the toilet, which are found buried with the unburnt skeletons, renders it difficult to decide which of the two methods of disposing of the dead was regarded as the more distinguished. The cranial type is generally dolichocephalous, with a retreating forehead and long, slightly prognathic face, resembling what is known in Germany as the 'Reihengräbertypus.' According to Sacken, the necropolis of Hallstatt dates from the third or fourth century B.C., revealing the presence in those regions of the eastern Alps of the so-called Galli Faurisci, who, prior to the Roman domination, must have been familiar with an advanced stage of civilization and decorative art, in which the influence of Greek art is undeniable. This is indeed strongly manifested both in the workmanship and the forms of multitudinous objects revealed by the exploration not merely of the Hallstattian tombs, but of the prehistoric station of Salzberg, whose discovery last year has added new interest to the still contested problem of the origin of the early culture of the Alpine races of central Europe."

— A successful experiment is reported to have been made recently at the laboratory of the Joseph Dixon Crucible Company, in Jersey City, N.J. A piece of iron ten inches long, two inches wide, and a sixteenth of an inch thick, was used, and one-half of its surface painted with silica-graphite paint, while the other half was left unpainted. It was suspended for several days in a bath of dilute sulphuric acid. This bath was much stronger than any sulphur-water met with in mining. On taking the iron from the bath, the unpainted part was found eaten off to about one-half its original

bulk. The painted part did not sustain even the slightest blemish, thus apparently proving the ability of this paint to withstand sulphuric acid, and demonstrating its usefulness where iron piping is laid in acid water, such as is sometimes met with in mines containing pyrite or other sulphides, which, under certain conditions, produce acid waters in the form of sulphate solutions, resulting from the decomposition of the sulphide minerals.

— We learn from *Nature* that some interesting facts concerning the element tellurium have been brought to light by Dr. Brauner of Prague during the course of a series of atomic weight determinations, an account of which is given in the July number of the *Journal of the Chemical Society*. A determination of the atomic weight of tellurium made by Berzelius in 1832 yielded the number 128.3; and a later one in 1857, by Von Hauer, gave the value of 127.9: hence 128 has usually been accepted as the true atomic weight. The properties of tellurium, however, indicate that it belongs to the sulphur group of elements, and that its position in the periodic system lies between that of antimony (of atomic weight 120) and iodine (of atomic weight 127); but, according to the above determinations, the atomic weight of tellurium is higher than that of iodine. Hence we are obliged to admit one of two things, — either that the atomic weight of pure elementary tellurium has been incorrectly determined, or that the periodic law of the elements, that grand natural generalization whose distinguished elaborator English chemists have recently been delighting to honor, breaks down in this particular case. In view of the overwhelming mass of experimental evidence which has now accumulated in support of this generalization, the latter assumption cannot for a moment be tolerated. The redetermination of Dr. Brauner becomes therefore of primary importance, and his results partake of the highest interest. The mode of procedure which afforded the most satisfactory results consisted in the analysis of tellurium tetrabromide ($TeBr_4$), purified in the most complete manner by means of silver nitrate prepared from pure silver. The mean atomic weight from these experiments was found to be 127.61; the maximum being 127.63, and the minimum 127.59: hence there can no longer be any doubt that the substance we term "tellurium" does possess a combining weight larger than that of iodine. Now comes the question, "Is this substance pure elementary tellurium?" If it is, then, as Dr. Brauner says, it is "the first element the properties of which are *not* a function of its atomic weight." Dr. Brauner, however, finds as the result of a process of fractionation that it is not pure tellurium, and that it consists of probably three elements, — pure tellurium mixed with smaller quantities of two other elements of higher atomic weights; and he is at present engaged in studying the nature of these foreign substances, and in the endeavor to isolate pure tellurium itself. A few of the as yet unpublished results obtained in these latter researches were communicated personally by Dr. Brauner at the meeting of the Chemical Society on June 6, and among them the interesting fact was stated that one of the new elements is probably identical with Professor Mendeleeff's recently predicted dwitellurium (of atomic weight 214), the other new constituent being an element closely allied to arsenic and antimony.

— "The principal business transacted at the Literary Congress at Paris, over which M. Jules Simon presided," says the London *Athenæum* of June 29, "has been the passing of the following resolutions, which it is to be hoped may be imported into the Convention of Berne, to which nearly every civilized nation, the United States of America excepted, adhered, and has legislated accordingly: 1. As an author's title to his work includes the sole right to translate it, or to authorize its translation, the author, his successors, and assigns enjoy the right of translation during the term of copyright, even though they may not have the sole right to reproduce the work in its original form; 2. There is no reason for an author notifying in any way that he reserves the right of translation; 3. There is no ground for limiting the period during which the author of a book or his representatives may translate it."

— Arrangements are being made by the local committee of the American Association at Toronto for an excursion, starting Sept. 3 or 4, to the Huronian district. Particulars will be given in a circular to be issued by the American Geological Society. Arrangements are also being made for an excursion to the Pacific coast. During the week, two popular lectures, complimentary to the citizens of Toronto, will be given by prominent members of the association. The Canadian Railway companies have made the following concessions to members from the United States who may wish to make local excursions during or after the meeting: Return tickets at single fare from Toronto to any station in Canada. Montreal and return, going and returning all rail, $8; going boat, returning rail, or *vice versa*, $10; or rail to Ottawa, river to Montreal, returning rail, $10. Quebec, going and returning all rail, $10; going steamer, returning rail, or *vice versa*, $12; rail to Ottawa, river to Quebec, returning rail, $12. Niagara Falls, going and returning all rail, $2.50; going rail and returning lake, or *vice versa*, $2; going lake and returning lake, $1.50.

— The Entomological Club of the American Association will meet at 9 A.M. on Wednesday, Aug. 28, in the room of Section F, University Buildings, Toronto, where members of the club will register and obtain the club badge. Members of the club intending to contribute papers will send titles to the president, Mr. James Fletcher, Government Experimental Farms, Ottawa, Can. The Botanical Club will hold a meeting as usual on Tuesday, Aug. 27, in the room of Section F, University Buildings. Communications should be sent to the president, Professor T. J. Burrill, Champaign, Ill., or to the secretary, Douglas H. Campbell, 91 Alfred Street, Detroit, Mich. During the week, members will be conducted by local botanists on excursions to points of interest in the neighborhood of Toronto. The Society for the Promotion of Agricultural Science will hold its tenth annual meeting in Toronto, beginning on Monday evening, Aug. 26, in the room assigned to Section I in the University Buildings, and continuing on Tuesday. For further information address Professor W. R. Lazenby, secretary, Ohio State University, Columbus, O. The American Geological Society will hold its meeting apart from Section E, in one of the halls of the university, on Aug. 28 and 29; Professor James Hall, Albany, N.Y., president, and Professor J. J. Stevenson, University of City of New York, secretary. For all matters pertaining to membership, papers, and business of the association, address the permanent secretary, at Salem, Mass., up to Aug. 20. From Aug. 20 until Sept. 9 his address will be A.A.A.S., Toronto, Ont.

— One of the most interesting features in the rapid approach of Cossack and Sepoy towards each other is the extensive planting of trees that is being carried on by the engineering branches of both countries, as reported in *Engineering*. Wherever stations are established in the Quetta district, trees, flowers, and vegetables are planted; and the same is the case with the new Russian settlements along the course of the Transcaspian Railway and the Oxus River. Of the two, the Russians have been more systematic than the English, and have spent considerably more money. This is due to the interest taken in the matter by Gen. Annenkoff, who is a born founder of colonies, and takes as much interest in all that appertains to the Transcaspian settlements as Robinson Crusoe did in his "desert island." At a recent meeting at St. Petersburg, Gen. Annenkoff gave an account of some of his operations in this direction. He admitted very frankly that the tree-planting of the last three years had not been altogether a success, many imported trees and shrubs having perished; but experience had shown what would and would not thrive, and seeds were being obtained from various parts of the world that would thrive in the sandy soil of the Kara Kum, exposed to the widest possible variations of heat and cold, or in the irrigated clayey expanses of the Merv, Tejend, and Atak oases. Meanwhile the Russian authorities are looking well after the local flora. Orders have been given that no bushes are to be cut down within ten miles of the line, and that the existing forests of saxaul are to be preserved. Saxaul is a kind of heavy, extremely knotted brier-wood, attaining a forest growth in places, and provides most of the fuel hitherto used in the country. It grows readily in sand, which it moreover serves to bind together by its long, trailing, clumsy roots. Plantations of this are to be made along the line, with camel thorn and other native bushes that thrive well, and it is expected that in time there will be a sufficient growth of vegetation not only to protect the line, but also to provide shelter for weaker trees and bushes of foreign origin. In the mean

while oil-refuse from Baku is being used as household fuel by the Russians, and, as soon as cheap suitable stoves are introduced, the population will probably become more and more accustomed to rely upon oil for fuel purposes. Every step in this direction is a boon, because it tends to save more and more the timber in Central Asia, and thereby contributes to a reforesting of a country once densely covered with trees, and at that period famous throughout Asia for its fertility. This fertility the Russian engineer is now attempting to gradually restore.

— The question of permeability of cements and mortars has been treated of by the board of experts appointed to report on the Washington Aqueduct Tunnel. In their report it is stated, that, even if the brick lining of the tunnel were carefully made and backed, still leakage could not be prevented, as bricks are themselves pervious under somewhat moderate heads. In some experiments made by Mr. Francis last year, about 13.8 gallons of water per square foot of surface passed through a thickness of nearly 16 inches cement in twenty-four hours, under a pressure of 77 pounds per square inch. Mr. Stauffer, another engineer, constructed a bulkhead of brick-work in cement in the Dorchester Bay Tunnel, which measures 10 feet by 10 feet. Under a pressure of 72 pounds per square inch, water percolated through at the rate of 96,000 gallons per day. Experience on the Boston main drainage work showed that it was not practicable to build a brick bulkhead which should be tight for pressures exceeding 64 pounds per square inch, and at the Croton Reservoir water under 36 feet head was found to percolate through 26 inches of brick-work and 4 feet of concrete. In some experiments made by the board of experts themselves, a good fair specimen brick was exposed to a pressure of 80 pounds per square inch on one of its faces; and, under these conditions, 23.4 cubic inches of water passed through the brick in the first hour, and 21.3 in the second hour. The mean of these figures is equivalent to 1.4 gallons per square foot of surface per hour. In the case of another brick under the same pressure, 46.8 cubic inches passed through in one hour. Blocks of cement mortar allowed to set for twenty-four hours in air, and afterwards hardened for five weeks in water, were also tested. Under 80 pounds pressure, water passed through these at the rate of 36.4 gallons of water per hour. The above figures have been reduced to English gallons of 10 pounds of water.

— The circular of the local committee for the meeting at Toronto, Ontario, Aug. 27 to Sept. 7, of the American Association for the Advancement of Science, states that arrangements have been made on the certificate plan for a very general reduction of railway-fares over the principal railways embraced in the territory of each of the different passenger agents' associations. Full fare for limited or unlimited tickets, as the case may be, will be paid going to Toronto, the purchaser receiving from the ticket-agent at the starting-point, or at the one nearest thereto in the association, a certificate giving the initials of the railways in the route to be traversed, and the amount of fare paid. A certificate must be taken covering the route in each passenger agent's association, if more than one is traversed. Conductors of trains and ticket-agents will be able to give full information as to the limits of each association's territory. Upon the presentation of such certificate, properly filled in and signed by the agent at the starting-point, and indorsed by the local secretary at Toronto, a return ticket will be sold, within three days after the meeting, for one-third the regular first-class fare. Return tickets will be sold at this price only over the route traversed in going to Toronto. Persons must obtain their blank certificates from the local secretary, Professor Loudon, at Toronto. These certificates will be mailed, with full instructions for their use, upon application to the local secretary. A separate certificate will be needed for each person coming to the meeting. Members and others making application for certificates will confer a favor upon the committee by enclosing an addressed envelope for the reply. The railway companies will adhere to the following rule: "No refund of fare will be made on any account whatever because of failure of the parties to obtain certificates." It will therefore be noticed that any person failing to obtain from the agent selling the ticket to Toronto, such a certificate as has been above described, will be obliged to pay full fare both ways. Those who desire to secure rooms in advance should communicate either directly with the hotels or with William McCulloch, secretary of the Young Men's Christian Association. The morning and afternoon meetings of the association and of its sections will be held in the University Buildings, Queen's Park, where will also be the offices of the permanent and local secretaries during the meeting. Hotel headquarters will be at "The Queen's," and the local committee's office in the vicinity at 42 York Street, where application may be made for information. In order to enable members to attend the morning and afternoon sessions without being obliged to go to the hotels in the interval, a luncheon will be served daily in the dining-hall, University College. Through the courtesy of the post-office authorities, there will be a branch post-office at the university during the meeting. All mail matter should be addressed "Care of A.A.A.S." The Great North-Western Telegraph Company has liberally offered to transmit free the social messages of members when approved by the secretary. No concessions could be obtained over the United States lines. The Canadian Express Company has generously offered to carry free packages containing scientific articles intended for use at the meeting. Members will receive whatever additional favors the local committee or the association may be able to secure or give, if they will send such packages in care of the local secretary. By the courtesy of the minister of customs, all articles intended for use at the meeting will be admitted free; subject, however, to inspection by the customs officers. In case any difficulty arises at the frontier, members are recommended to ship the articles by express in bond to the local secretary. Full reports of the proceedings will be published in the Toronto daily papers. Authors will oblige by sending, in advance, abstracts of their papers (other than those sent to the permanent secretary) to James Hedley, *Monetary Times*, Toronto, who will withhold them from publication until the papers have been read in the sections. The council will meet at the Queen's Hotel at noon on Tuesday, Aug. 27. The association will be called to order in general session at 10 A.M., on Wednesday, Aug. 28, in the University Convocation Hall, by the president, Major J. W. Powell of Washington, who will resign the chair to the president-elect, Professor T. C. Mendenhall of Terre Haute, Ind. After the adjournment of the general session, the sections will organize in their respective halls. In the afternoon the sections will meet and the vice-presidents deliver their addresses. In the evening Major Powell will deliver the presidential address in the Pavilion, Horticultural Gardens. The meetings of the sections will be held on the following days (except Saturday and Sunday) until Tuesday night, when the concluding general session will take place. Saturday will be devoted to excursions complimentary to the association, including one to Niagara Falls and one to Muskoka.

— Thomas G. Farrell writes from Portland, Ore., to the *American Field*, that, the varieties of native song-birds in this country being rather limited, several German citizens some time since conceived the idea of importing a number of German song-birds. In a few days quite a respectable sum was raised for this purpose, and forwarded to Germany. Not long since, the birds arrived in charge of a competent keeper, and, after being placed on exhibition for a few days, were all turned loose to multiply and prosper. There were some three hundred birds in all, consisting mainly of chaffinches, goldfinches, greenfinches, bullfinches, starlings, nightingales, skylarks, German robins, linnets, thrushes, grossbeaks, and, last but not least, several specimens of the singing-quail. It is understood that many of them have been observed nesting, and it is very likely that they will form a valuable addition to our feathered family.

— At a recent meeting of the German Meteorological Society in Berlin, according to *Nature*, Dr. Lang of Munich read a paper on "The Velocity of Propagation of Thunder-Storms in South Germany in the Ten Years 1879–88." This is, on an average, 38.4 kilometres per hour; but it has varied considerably from year to year, increasing in the years to 1884, and thereafter decreasing. To this corresponds a curious variation of Van Bebber's fourth and fifth depression-paths, which lay in the north at the beginning of the period, then moved south to South Germany till 1884, after which they retired northwards. Hail frequency has varied in an

opposite sense to the velocity; but the rapidly moving winter thunder-storms have most hail. The velocity is maximum in winter: it falls rapidly till May, slowly rising thereafter (with a second depression in September) till winter. The velocity is greatest in storms coming from the west. Dividing the region into four zones from north to south, there is a decrease in the velocity, at first slight, but getting very rapid on reaching the Alpine region. The velocity is greatest about midnight, least about midday. At the same meeting, thunder-storms and hail in Bavaria in 1880–88 were the subject of a paper by Dr. Horn. These phenomena in general correspond. Both have a maximum early in July; but the hail has a second maximum, nearly as great, in May. Both phenomena show a pronounced day maximum about 3 to 4 (in winter about 2 to 3), and a minimum in the morning from 7 to 8. Dr. Horn said hail never fell in Bavaria without electric discharge, but Dr. Assmann maintained it did sometimes in Prussia.

— The Transvaal Volksraad is reported to have placed $100,000 on the estimates for the current year, for the purpose of endowing the first university of the Republic.

— The monograph prepared by Mr. C. Meriwether, A.B., Johns Hopkins University, and recently published by the United States Bureau of Education, is designed to trace the history of higher education in South Carolina, his native State, and to give a sketch of the development of the free or public school system. The earliest educational efforts are described, and instances are given illustrating the interest of South Carolina when yet a colony in providing the means for the intellectual improvement of her sons. Not only were schools founded and maintained in the province by the government and through private and charitable aid, but many youths were sent to England for their education. The influence of such men on their return was so great and lasting, that, even to the middle of the present century, schools in Charleston, modelled on the English plan, were very popular. The birth of colleges was late, and their growth slow: there was, therefore, chance for a good system of academies to develop. These were planted in all parts of the State, so that a good training-school was within the reach of all. The number continued to increase until the outbreak of the war. The most famous academy was that presided over by Dr. Moses Waddel, the Thomas Arnold of South Carolina. Although there is mention, in the House Journal of 1723, of a proposal to establish a college, and a bill was introduced into the colonial Legislature in 1769 for this purpose, yet no action was taken until the present century. An act was passed in 1785, establishing three colleges in the State, yet only one of them ever gave collegiate instruction. The College of Charleston, while its foundation can be traced to the legislative act of 1785, has given collegiate instruction only since the first quarter of the present century. It is supported very largely by income from vested funds, the result of endowment by public-spirited citizens in and near Charleston. Over half the three hundred thousand dollars endowment was given by Mr. Baynard, during the war, in 1864. The attendance has not been large, but the training in mathematics and ancient languages has always been thorough. Every denomination of any strength in the State has founded a college. In the main, they follow the average college course, but, owing to want of funds, they cannot offer very many electives. It is gratifying to state that the funds and attendance of nearly all of them are gradually increasing. The war was most disastrous to all these institutions in sweeping away their endowments. The first attempt made to establish a general system of free schools was in 1811. The act was passed after bitter opposition on the part of some of the up-country members, and provided free instruction for all children, but gave the preference to poor children; but although the annual appropriations were doubled in 1852, being made seventy-four thousand dollars, the universal testimony was that the schools were a failure. On the adoption of a new State constitution in 1868, the present public-school system was introduced. Its usefulness has been greatly increased by the efficient management since 1876. The attention paid by the State to the education of the colored citizens is well illustrated in Claflin University, supported largely by the State. It has seventeen teachers and six courses of instruction, and its students at the last session numbered nine hundred and forty-six. The most important phases of advanced instruction in South Carolina are those connected with the State institutions. The Military Academy at Charleston was designed to furnish trained soldiers for South Carolina. Its course is modelled after that of West Point. The College of South Carolina is the best of all the institutions in the State. It was opened for students in 1804, and has ever since exercised a strong influence on the politics of South Carolina, except during the reconstruction period. Every politician of any note in the State, except John C. Calhoun, has been for a time connected with the institution.

— Since the perfection of the silo, maize or corn has come to have an increased importance in successful agriculture, especially in dairying and stock-growing. The value of corn for the silo and as a forage crop is a sufficient incentive for making a thorough and systematic study of the development of, and chemical changes in, maize during its period of growth. This work was begun last year in a preliminary way at the New York Agricultural Experiment Station, and is being continued in more detail the present season. When this season's work is completed, it is hoped the results may answer the question, "What is the proper stage of maturity for cutting corn for the silo?" To every farmer who is interested in the silo, three important questions present themselves for consideration: 1. What is the best variety of corn to grow for the silo? 2. What is the best method of planting? 3. What is the proper stage of maturity for cutting corn for the silo? As the result of experiment, the following conclusions are probable: 1. That the greatest weight of green fodder seems to have been at about the period of full silking of the ears; 2. That the total weight diminished after this date, but the total dry matter increased; 3. That the total nitrogen does not appear to increase after the ears silk; 4. That as the corn approaches maturity the per cent of amide nitrogen diminishes, while the albuminoid nitrogen increases, thus seemingly increasing the feeding-value of the crop; 5. That the sugars and starch increase rapidly during the latter period of growth and maturing of the corn-plant, and that these are the most valuable portion of the nitrogen-free extract; 6. That for the greatest amount of nutriment, considered from a chemical standpoint, corn should not be cut before it has reached the milk stage of the kernel; 7. That it remains for future investigation to determine whether it is better to be cut at the milky stage or at a later period for the greatest amount of digestible and available nutriment; 8. That the Burrell & Whitman corn cannot, in ordinary culture, be matured in this latitude.

— It is well known that plants of *Dictamnus fraxinella*, at the close of a dry, sunny day, are surrounded by a gas which is inflammable, and will ignite with a sudden flash of flame when a lighted match is applied to it. M. H. Correvon gives in *The Garden* the results of some investigations lately made with regard to this phenomenon. Certain plants, and very notably the *Rutaceæ* and *Labiatæ*, secrete various products, such as essential oils, resins, gums, balsams, etc. Secretory organs which are buried in the substance of the parenchyma elaborate these products, while hairs of various forms and textures conduct them to the surface, and there excrete them. The secretory organs are termed "internal glands," and the excretory hairs are known as "external glands." These latter glands are surrounded at the base by a part of the epidermis, which the hair has pushed up in issuing forth to make its appearance on the surface of the stem, and in the *fraxinella* this raised part of the epidermis covers a gland which is very richly provided with resin and essential oil. When this gland was examined with a microscope on a hot day, it was empty, its contents having been drawn out by the heat through the cells of the epidermis or through the hair that terminates the gland. It must be understood that the surrounding air has to be pretty strongly impregnated with the gas of the volatilized resin in order to take fire when a lighted match is applied to it. This experiment has also been carried out in France by placing a pot-plant of *fraxinella* in bloom under a bell-glass, and leaving it there for some time, when the air in the bell-glass was found to be so highly charged with the resinous gas that it ignited the moment a lighted match was applied to it, and, it may be added, without doing the slightest injury to the plant.

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CONTENTS:

THE WORLD'S-FAIR PROJECT is moving on favorably. A meeting of prominent representatives of American industries was held at the office of the mayor of New York, where it appeared that the proposition was well received by this class, upon whose efforts success will depend. At this season many of New York's prominent men are out of town, but there is no evidence that this will interfere with the preliminaries of organization. Among the suggestions floating in the air is that there should be minor exhibitions in some of the other large cities of the United States, but it does not appear that this side-show business will meet with acceptance. At the mayor's meeting the appointment of four preliminary committees was decided on; and the mayor is using due effort to secure the right material for these, having invited the various commercial and industrial organizations for suggestions. The finance committee will be called on to secure a guaranty of something like $15,000,000. The committee on the site will have necessarily a delicate task, in view of the enormous interests which will be affected; but, with the many points in New York which can be reached by land and water, there will be ample opportunity for a good choice. The matter of legislation will call for due attention, and, the more rapidly some results of the organization are to be shown, the better will be the prospect of recognition at the hands of Congress and the Legislature. What can be said now is that the scheme takes with those who will carry it through.

WE WOULD CALL ATTENTION to the letter by Dr. Lamborn in this issue. We think all will agree that scientific methods should be sought to lessen the number of mosquitoes, and that, where even a glimmer of light is seen promising that consummation, it should be followed by scientific men with the utmost vigor. New Jersey alone could afford to spend a million dollars a year on any plan that would largely lessen her mosquito-product. The life-history of any dragon-fly is yet but little known, and the characteristics as destroyers of small insects of many of the scores of species of dragon-flies is even less known. This attempt to get at facts to reason upon we hope will meet with the aid of scientific persons throughout the country, and that, with the results of this season's work before us, we may be able to conclude how far the dragon-fly may be used for the ends mentioned in Dr. Lamborn's letter.

CONSIDERATIONS CONCERNING SOME EXTERNAL SOURCES OF INFECTION IN THEIR BEARING ON PREVENTIVE MEDICINE.

(*Continued from p.* 73.)

As regards anthrax bacilli, it has been determined that in ordinary garden or field earth they do not multiply, but in earth contaminated by blood, urine, or fæces, their reproduction can occur. They can grow on various vegetable substrata. There is no reason to doubt, therefore, that the anthrax bacilli can find in or on the ground suitable conditions for their multiplication, although such conditions are not everywhere present. For durable infection of the soil with anthrax bacilli, it is, however, more important that these bacilli should find there suitable conditions for the formation of spores than that they should be able simply to multiply. The vegetative forms of anthrax bacilli would not, as a rule, be able to survive for a great length of time the hostile influences which they are likely to encounter in the ground; such as insufficient or exhausted nutriment, absence of sufficient moisture, and the attacks of saprophytic organisms. On the other hand, against these injurious influences the anthrax spores have great resistance. In the superficial layers of the ground the anthrax bacilli may often find those conditions of moisture, of temperature, of oxygen-supply, and of insufficient food, which we know are most favorable for the development of their spores: indeed, Soyka has shown that the ground presents often these conditions better than our culture media. A circumstance discovered by Feltz, which, however, needs confirmation, is, if true, of not little significance. He finds that anthrax bacilli may undergo a progressive diminution in virulence in the soil. If this should be true likewise of other infectious micro-organisms, we should be able to account in some instances for the variable degree of virulence which clinical observation indicates that certain agents of infection acquire. So far as anthrax bacilli are concerned, we may conclude, therefore, that the ground occasionally offers suitable conditions for their reproduction; but, what is of greater importance, it offers especially favorable conditions for their long-continued preservation in the form of spores. I must forego here the further consideration of the special circumstances inherent in the soil which control the origin and spread of epidemics of anthrax in cattle, although many interesting investigations have been directed to this subject.

Of greater interest to physicians is the behavior of typhoid and of cholera bacteria in the ground. As has already been intimated, the ground is regarded by Pettenkofer and his school as the principal breeding-place of these micro-organisms outside of the body. This view, however, is not supported by bacteriological investigations. Inasmuch as the cholera and typhoid bacilli may multiply on various vegetable substrata and substances derived from animals at temperatures often present in the ground, it is evident that here and there conditions may be present for their growth in the ground; but this growth is likely to be soon interrupted by the invasion of ordinary saprophytic organisms and other harmful influences. The typhoid bacilli are more hardy in resisting these invaders than are the cholera bacteria, which easily succumb; but even for the for-

mer, so far as our present knowledge extends, the ground can rarely serve as a favorable breeding-place.

It is not, however, necessary that these organisms should multiply in order to infect for a considerable time the ground : it is sufficient if their vitality is preserved. As to this latter point, the reports of different investigators are not altogether concordant. Such excellent observers as Koch, Kitasato, and Uffelmann found that the cholera bacteria, when added to fæces, or a mixture of fæces and urine, rapidly diminished in number, and at the end of three or four days, at the most, had wholly disappeared. In a mixture of the intestinal contents from a cholera corpse with earth and water, Koch found numerous cholera bacteria at the end of three days, but none at the end of five days. On the other hand, Gruber reports the detection of cholera bacteria in cholera dejecta fifteen days old. The weight of bacteriological evidence, therefore, is opposed to the supposition that the bacteria of Asiatic cholera preserve their vitality for any considerable time in the ground or in the excreta.

With respect to the bacilli which cause typhoid-fever, it has been shown by Uffelmann that these may live in fæces, a mixture of fæces and urine, and a mixture of garden earth, fæces, and urine, for at least four and five months, and doubtless longer, although they may die at the end of a shorter period. He also finds that under these apparently unfavorable conditions some multiplication of the bacilli may occur, although not to any considerable extent. Grancher and Deschamps found that typhoid bacilli may live in the soil for at least five months and a half. Unlike the cholera bacteria, therefore, the typhoid bacilli may exist for months at least in the ground and in fæcal matter, holding their own against the growth of multitudes of saprophytes. This difference in the behavior of cholera and of typhoid germs is in harmony with clinical experience.

As regards other infectious bacteria than those which have been considered, I shall only mention that tubercle bacilli, although incapable of multiplication under the ordinary conditions of nature outside of the body, may preserve their vitality for a long period in the ground, on account of their resistant character, and, furthermore, that the pyogenic cocci, on account of their considerably resistant nature and their modest demands in the way of nutriment, can be preserved and sometimes probably grow in the ground. Indeed, the *Staphylococcus pyogenes aureus* has been found in the earth by Lübbert.

The conclusion which we may draw from the observations mentioned, is that in general the soil is not a good breeding-place for most of the infectious bacteria with which we are acquainted, but that it can retain for a long time with unimpaired vitality those which produce spores or which offer considerable resistance to injurious agencies, such as anthrax bacilli, typhoid bacilli, tubercle bacilli, and the pyogenic cocci.

In order to become infected with bacteria in or on the ground, these bacteria must in some way be introduced into the body; and we must therefore now attempt to determine how bacteria may be transported to us from the ground. So various and intricate are the possibilities for this transportation, that it is hopeless to attempt to specify them all.

There occurs to us first the possibility of the conveyance of infectious micro-organisms from the soil by means of currents of air, — a mode of carrying infection which has already been considered. Here I shall only repeat that the wind can remove bacteria from the ground only when the surface is dry and presents particles of dust, and that the sole, perhaps the chief, danger is not that we may inhale the infected dust.

Manifold are the ways in which we may be brought into contact with infectious bacteria in the ground, either directly or by means of vegetables to which particles of earth are attached, by the intervention of domestic animals, by the medium of flies or other insects, and in a variety of other ways more or less apparent.

An important, doubtless for some diseases the most important, medium of transportation of bacteria from an infected soil is the water which we drink or use for domestic purposes. From what has been said, it is evidently not the subsoil-water which is dangerous, for infectious, like other bacteria, cannot generally reach this in a living state; but the danger is from the surface-water, and from that which trickles through the upper layers of the ground, as well as from that which escapes from defective drains, gutters, cesspools, privy-vaults, and wrongly constructed sewers or improper disposal of sewage. I shall have something to say presently of water as a source of infection, and shall not further elaborate here the dangers of infection of drinking-water through contaminated soil, — dangers which, especially as regards typhoid-fever, are widely appreciated in this country, even if often imperfectly counteracted.

A point which has been much discussed, and one of interest, is whether bacteria which are in the depth of the ground can come to the surface. Two agencies, especially, have been considered by some as capable of transporting bacteria from the depth to the surface. One is ascending currents of air in the ground, and the other is the capillarity of fluids in the minute pores of the ground. The first of these suspected agencies must be unquestionably rejected, in view of the fact that even a few inches of sand is sufficient to filter all of the bacteria out of the air, even when it is in much more rapid motion than can occur within the ground. Moreover, that degree of dryness which is essential for the detachment of bacteria by air-currents is not likely to be present much below the surface of the ground. The experiments which have been made to determine to what extent bacteria may be carried upward by the capillarity of fluids in the ground have not yielded harmonious results, but the weight of evidence is opposed to the belief that this is a factor of any considerable importance for this purpose.

From what has been said concerning the growth of pathogenic bacteria in the soil, we shall not be inclined to attribute to the multiplication and the motility of these organisms much influence in changing their place in the ground.

The somewhat sensational *rôle* assigned by Pasteur to earthworms, of bringing bacteria to the surface, cannot be wholly ignored, and has received support from observations of Bollinger regarding anthrax; but it is questionable whether much importance is to be attached to this agency.

Regarding the depth to which typhoid bacilli may penetrate in the soil, the experiments of Grancher and Deschamps show that at the end of five weeks they may reach a depth of sixteen to twenty inches below the surface. As Hoffmann has demonstrated the extraordinary slowness with which fluids and fine particles penetrate the soil, it is probable that in the course of time a greater depth than this may be reached. Indeed, Macé claims to have found, in the neighborhood of a well suspected of infection, typhoid bacilli, together with ordinary intestinal bacteria, at a depth of at least six and a half feet below the surface. There are a number of instances recorded in which there is good reason to believe that turning up the soil, and cleaning out privies or dung-heaps in which typhoid stools have been thrown, have given rise to typhoid-fever, even after the infectious excreta have remained there a year and more.

It cannot be said that bacteriological investigations have as yet shed much light upon a factor which plays a great *rôle* in epidemiology, namely, predisposition to infection from the ground, according to locality and time; and this deficiency receives constant and vehement emphasis from the localistic school of epidemiologists. We can, however, readily understand that varying conditions, such as temperature, moisture, porosity, quality of soil, may exert a controlling influence in determining the behavior of infectious germs in the soil, and the facility of their transportation to human beings or animals. As regards that much-discussed question, the significance of variations in the height of the subsoil-water in relation to the prevalence of certain epidemic diseases, particularly cholera and typhoid-fever, we now know that this cannot depend upon the presence of bacteria in the subsoil-water itself, or in the capillary layers immediately above it. It has been plausibly suggested, that, with the sinking of the subsoil-water, fluids from infected cesspools, privy-vaults, and other localities, may more readily be drawn into wells or other sources of water-supply, and that by the same cause the surface of the ground becomes dry, so that dust-particles may be lifted by the wind. Other more or less plausible explanations have also been offered, but it must be confessed that our positive information on this point is meagre. There can, how-

ever, be little doubt that this significance of the variations in subsoil-water is apparent only for certain localities, and has been considerably exaggerated and often misunderstood. It is not, however, pertinent to my theme to discuss this or other purely epidemiological observations concerning the relations of the ground to the spread of epidemic diseases, interesting and important as are many of these observations.

Before leaving the subject of the ground as a source of infection, permit me to indicate briefly some conclusions which may be drawn from what has been said, as to the principles which should guide us in preventing infection, directly or indirectly, from the ground.

First in importance is to keep infectious substances as far as possible from the ground. This implies the early disinfection or destruction of such substances as typhoid and cholera excreta and tuberculous sputum.

Second, the ground should be rendered, so far as practicable, unsuitable for the continued existence of infectious germs. This, at least for some diseases, is accomplished by a proper system of drainage; which, moreover, for other reasons, possesses hygienic importance.

Third, means should be provided to prevent waste products from getting into the ground around human habitations, or from gaining access to water used for drinking or domestic purposes. In cities this can be accomplished only by a properly constructed system of sewers. The system of storing waste products in cesspools, whence they are to be occasionally removed, cannot be approved on hygienic grounds. There are conditions in which the disposal of waste products in deep wells only used for this purpose, and whence these products can filter into the deep layers of the ground, may be permissible; but this can never be considered an ideal method of getting rid of excrementitious substances, and is wholly wrong in regions where wells are used for drinking-water. But I am trespassing with these remarks upon a province which does not belong to me, but rather to practical sanitarians and engineers. I shall only add that the advantage gained by preventing organic waste from soaking into the ground is not so much that the ground is thereby rendered better adapted for the existence of infectious micro-organisms, but is due rather to the fact that this waste is likely to contain infectious germs.

Finally, in cities, good pavements, absence of unnecessary disturbance of the soil, cleanliness of the streets, and laying of dust by sprinkling, are not only conducive to comfort, but are sometimes hygienically important in preventing infection from the ground and dust.

In passing from the consideration of the ground to that of water, one feels that he now has to do with a possible source of infection against which, in this country and in England, he is at liberty to make any accusation he chooses without fear of contradiction. There is reason to believe that such accusation has been repeatedly made, without any proof of misdemeanor on the part of the water. It is not, therefore, with any desire to awaken further the medical or the public conscience that I wish to say a few words concerning the behavior of bacteria in water, and the dangers of infection from this source. That such dangers are very real must be apparent when we consider the universal employment of water, and its exposure to contamination from all kinds of sources.

Ordinary water, as is well known, contains bacteria in large number. Not a few species of bacteria can multiply rapidly, and to a large amount, even in distilled water. These are the so-called water bacteria, and, like most of the micro-organisms found in ordinary drinking-water, are perfectly harmless saprophytes. What we wish to know is, how pathogenic micro-organisms conduct themselves in water. Can they grow, or be preserved for any length of time in a living condition, in water? As regards the multiplication of pathogenic bacteria in water, the results of different experimenters do not altogether agree. Whereas Bolton failed to find any growth, but rather a progressive diminution, in number of pathogenic bacteria planted in sterilized water, Wolffhügel and Riedel observed a limited reproduction of such bacteria, including those of typhoid-fever and of cholera. This difference is due probably to the methods of experimentation employed. According to Kraus, these latter bacteria diminish rapidly in number in unsterilized spring or well water kept at a low temperature. These experiments indicate that water, even when contaminated with more organic impurities than are likely ever to be present in drinking-water, is not a favorable breeding-place for pathogenic bacteria. Still it is to be remembered that these laboratory experiments do not reproduce exactly all of the conditions in nature; and it may happen that in some nook or cranny, or vegetable deposit at the side of a well or stream, some pathogenic bacteria may find suitable conditions for their multiplication.

But, as has been repeatedly emphasized in this address, it is not necessary that pathogenic bacteria should actually multiply in a medium in order to render it infectious. It is sufficient if their life and virulence are not destroyed in a very short time. As to this important point, Bolton found that in sterilized water typhoid bacilli may preserve their vitality for over three months, and cholera bacteria for eight to fourteen days, while Wolffhügel and Riedel preserved the latter in water for about eighty days. Under natural conditions, however, these organisms are exposed to the overgrowth of the water bacteria; so that Kraus found in unsterilized water kept at a temperature of 10.5° C. the typhoid bacilli no longer demonstrable after seven days, and the cholera bacteria after two days. The conditions in Kraus's experiments were as unfavorable as possible for the continued existence of these pathogenic bacteria, more unfavorable than those often present at the season of prevalence of cholera and typhoid-fever; nevertheless I do not see that they justify the conclusions of Kraus as to the slight probability of drinking-water ever conveying infection with the germs of typhoid-fever and of cholera. To render such a conclusion probable, it would be necessary to demonstrate a much shorter preservation than even Kraus himself found. In judging this question, it should not be overlooked that infection of drinking-water with the typhoid or the cholera germs is not so often the result of throwing typhoid or cholera stools directly into the source of water-supply as it is the consequence of leaky drains, cesspools, privy-vaults, or infected soil; so that there may be continued or repeated accessions of infected material to the water.

In view of the facts presented, there is no sufficient reason, therefore, from a bacteriological point of view, for rejecting the transmissibility of typhoid-fever and cholera by the medium of the drinking-water. This conclusion seems irresistible when we call to mind that Koch once found the cholera bacteria in large numbers in the water of a tank of India, and that the typhoid bacilli had been repeatedly found in drinking-water of localities where typhoid-fever existed. Nor do I see how it is possible to interpret certain epidemiological facts in any other way than by assuming that these diseases can be contracted from infected drinking-water, although I know that there are still high authorities who obstinately refuse to accept this interpretation of the facts.

In this connection it may be mentioned that pathogenic bacteria may preserve their vitality longer in ice than in unsterilized drinking-water. Thus Prudden found typhoid bacilli still alive which had been contained in ice for one hundred and three days.

When we come to consider the ways in which water may become infected with pathogenic micro-organisms, we recognize at once a distinction in this respect between surface-water and subsoil-water. Whereas the subsoil-water may be regarded under ordinary circumstances and in most places as germ-free, the surface-water, such as that in rivers and streams, is exposed to all manner of infection from the ground, the air, and the direct admission of waste substances. Unfortunately, in the ordinary way of obtaining subsoil-water for drinking purposes by means of dug wells, this distinction is obliterated; for the water which enters these wells free from bacteria is converted into a surface-water often exposed, by the situation of the well, to more dangerous contamination than other surface-waters used for drinking purposes.

Now let us turn our attention, as we have done with other sources of infection, to a brief outline of certain general principles which may help us in avoiding infection from the water.

We shall, in the first place, avoid, so far as possible, the use of water suspected of infection, especially with the germs of such diseases as typhoid-fever and cholera. When it is necessary to use this suspected water, it should be boiled.

As regards the vital question of water-supply, it may be stated as a general principle that no hygienic guaranty can be given for the purity of surface-water which has not been subjected to a proper system of filtration, or for the purity of spring or well water fed from the subsoil, unless such water is protected from the possibility of infection through the upper layers of the soil or from the air. This is not saying that water which meets certain chemical and biological tests, and which is so situated that the opportunities for its contamination appear to be absent or reduced to a minimum, is not admissible for the supply of drinking-water; but the possibility of infection can be removed only by the fulfilment of the conditions just named, and upon these conditions the hygienic purist will always insist.

Unfortunately we have at present no domestic filters which are satisfactory; and most of those in common use are worse than none, as they soon furnish a filtrate richer in bacteria than the original water. The only effective method of water-filtration for the general supply is by means of large sand-filters, such as are in use, with excellent results, in Berlin and some other cities. These require skilled attention. I cannot on this occasion discuss the construction or working of these filters, but would refer those who are interested to the full and careful investigations of the Berlin filters by Wolffhügel and by Plagge and Proskauer.

What is accomplished by these artificial sand-filters is accomplished under natural conditions also by the ground, which furnishes a subsoil-water free from micro-organisms; and to obtain pure water we have only to devise means by which this subsoil-water may be secured without the chance of contamination. Just as the water which has passed through the sand-filters is collected in suitable reservoirs, and is distributed in pipes which do not admit contamination from without, so, by means of properly constructed artesian or driven wells, we may secure the naturally filtered subsoil-water with the same freedom from the chances of infection.

It is well to bear in mind that no biological or chemical tests of water can replace those measures which have been mentioned as necessary to secure purity of water-supply. These tests are of value only when applied with proper precautions, and with due consideration of the special circumstances of each case for which they are employed. There has been much profitless discussion as to whether greater significance is to be attached to the chemical or to the bacteriological examination of water. Each has its own special field of application, and in this the one cannot replace the other method. The bacteriological examination has for hygienic purposes the advantage that it may enable us to detect the specific agents of infection in the form of micro-organisms, as has already been done for cholera bacteria and typhoid bacilli; but this is a comparatively rare result, and does not at present afford a wide field of application for this method. The significance of the bacteriological test is to be based more frequently upon the fact that it concerns itself with the same class of micro-organisms to which some of the recognized, and doubtless many of the undiscovered, infectious agents belong, and from the behavior of which, in some respects, conclusions can be drawn as to the behavior of the pathogenic organisms. Thus the bacteriological test is the only one which enables us to judge correctly of the efficacy of those methods of filtration of surface-water and of construction of wells which insure purity of water-supply. The points of view from which we can estimate correctly, according to our present knowledge, the relative merits and fields of application of the chemical and of the bacteriological methods of water-examination, have been clearly indicated by Plagge and Proskauer, and by Wolffhügel. The theme is one beyond the limits or the scope of this discourse; and I have referred to it chiefly to emphasize the fact that we cannot rely upon chemical or bacteriological tests of water to the exclusion of those protective measures which have been mentioned although I do not intend to imply that each of these tests, when properly employed, does not afford important information and is not of great value in many cases.

I have already taxed so largely your time and patience, that I must pass over with brief mention the food as a source of infection. Unlike those external sources of infection which we have hitherto considered, many articles of food afford an excellent nutritive medium for the growth of a number of species of pathogenic micro-organisms, and in many instances this growth may be abundant without appreciable change in the appearance or taste of the food.

When we consider in how large a degree the certainty and the severity of infection with many kinds of pathogenic micro-organisms depend upon the number of such organisms received into the body, we can appreciate that the danger of infection from food which contains a mass of growing pathogenic bacteria may be much greater than that resulting from the reception of infected water or air, — media in which infectious organisms are rarely present in other than a very dilute condition. The entrance into the body of a single infectious bacterium with the inspired air is, at least in the case of many diseases, not likely to cause infection; but let this bacterium fall upon some article of food, as, for instance, milk, where it can multiply in a short time at a favorable temperature many thousand-fold, and evidently the chances of infection become vastly increased.

Among the various agencies by which infectious organisms may gain access to the food may be mentioned the deposition of dust conveyed by the air; earth adhering to vegetables; water used in mixing with or in the preparation of food, in cleansing dishes, cloths, etc.; and contact in manifold other ways with infected substances.

Fortunately a very large part of our food is sterilized in the process of cooking shortly before it is partaken, so that the danger of infection from this source is greatly diminished, and comes into consideration only for uncooked or partly cooked food, and for food which, although it may have been thoroughly sterilized by heat, is allowed to stand for some time before it is used. Milk, in consequence of its extensive use in an unsterilized state, and of the excellent nutritive conditions which it presents to many pathogenic bacteria, should be emphasized as especially liable to convey certain kinds of infection, — a fact supported not less by bacteriological than by clinical observations. Hesse found that also a large number of ordinary articles of food, prepared in the kitchen in the usual way for the table, and then sterilized, afford a good medium for the growth and preservation of typhoid and cholera bacteria, frequently without appreciable change in the appearance of the food.

Upon solid articles of food, bacteria may multiply in separate colonies, so that it may readily happen that only one or two of those who partake of the food eat the infected part; whereas with infected liquids, such as milk, the infection is more likely to be transmitted to a larger number of those who are exposed.

In another important particular the food differs from the other sources of infection which we have considered. Not only the growth of infectious bacteria, but also that of bacteria incapable of multiplication within the body, may give rise in milk and other kinds of food to various ptomaines, products of fermentation, and other injurious substances, which, when ingested, are likely to cause more or less severe intoxication, or to render the alimentary tract more susceptible to the invasion and multiplication of genuinely infectious organisms.

It is plain that the liability to infection from food will vary according to locality and season. In some places and among some races the proportion of uncooked food used is much greater than in other places and among other races. In general, in summer and in autumn the quantity of fruit and food ingested in the raw state is greater than at other seasons; and during the summer and autumn there is also greater danger from the transportation of disease-germs from the ground in the form of dust, and the amount of liquids imbibed is greater. The elements of predisposition, according to place and time, upon which epidemiologists are so fond of laying stress, are not, therefore, absent from the source of infection now under consideration.

I have thus far spoken only of the secondary infection of food by pathogenic micro-organisms; but, as is well known, the substances used for food may be primarily infected. Chief in importance in the latter category are the various entozoa and other parasites which infest animals slaughtered for food. The dangers to mankind resulting from the diseases of animals form a separate theme, which would require more time and space than this address affords for their proper consideration. I shall content myself on

this occasion with only a brief reference to infection from the milk and flesh of tuberculous cattle.

It has been abundantly demonstrated by numerous experiments that the milk from tuberculous cows is capable, when ingested, of causing tuberculosis. How serious is this danger may be seen from the statistics of Bollinger, who found, with cows affected with extensive tuberculosis, the milk infectious in eighty per cent of the cases; in cows with moderate tuberculosis, the milk infectious in sixty-six per cent of the cases; and in cows with slight tuberculosis, the milk infectious in thirty-three per cent of the cases. Dilution of the infected milk with other milk or with water diminished, or in sufficient degree removed, the danger of infection. Bollinger estimates that at least five per cent of the cows are tuberculous. From statistics furnished me by Mr. A. W. Clement, V.S., it appears that the number of tuberculous cows in Baltimore which are slaughtered is not less than three to four per cent. Among some breeds of cattle, tuberculosis is known to be much more prevalent than this.

There is no evidence that the meat of tuberculous cattle contains tubercle bacilli in sufficient number to convey infection, unless it be very exceptionally. Nevertheless one will not willingly consume meat from an animal known to be tuberculous. This instinctive repugnance, as well as the possibility of post-mortem infection of the meat in dressing the animal, seems to be good ground for discarding such meat. The question, however, as to the rejection of meat of tuberculous animals, has important economic bearings, and has not been entirely settled. As to the rejection of the milk from such animals, however, there can be no difference of opinion, although this is a point not easily controlled.

The practical measures to adopt in order to avoid infection from the food, are, for the most part, sufficiently obvious; still it is not to be expected that every possibility of infection from this source will be avoided. It is difficult to discuss the matters considered in this address without seeming to pose as an alarmist; but it is the superficial and half knowledge of these subjects which is most likely to exaggerate the dangers. While one will not, under ordinary circumstances, refrain from eating raw fruit or food which has not been thoroughly sterilized, or from using unboiled or natural waters in the fear that he may swallow typhoid or cholera bacteria, still, in a locality infected with cholera or typhoid-fever, he will, if wise, not allow himself the same freedom in these respects. Cow's milk, unless its source can be carefully controlled, should, when used as an habitual article of diet, as with infants, be boiled, or the mixed milk of a number of cows should be selected; but this latter precaution offers less protection than the former.

In most places in this country we are sadly lacking in good sanitary inspection of the food, especially of the animal food, offered for sale. One cannot visit the slaughter-house in Berlin or in Munich (and doubtless similar ones are to be found elsewhere), and watch the intelligent and skilled inspection of the slaughtered animals, without being impressed with our deficiency in this respect. In large cities an essential condition for the efficient sanitary inspection of animal food is that there should be only a few places, and preferably only one place, where animals are permitted to be slaughtered. Skilled veterinarians should be selected for much of the work of inspection.

It may reasonably be asked that the national government, which has already spent so much money for the extermination of such diseases as pleuro-pneumonia of cattle and hog-cholera, which are not known to endanger the health of mankind, should turn its energies also to means for eradicating tuberculosis from cattle, which is a scourge not only to the economic interests of farmers and dairymen, but also to the health of human beings.

Without any pretension to having done more in this address than to sketch here and there a few principles derived from bacteriological researches concerning only some of the most widely distributed external sources of infection, I trust that enough has been said to show the folly of any exclusive dogma as to modes of infection. The ways of infection even in one and the same disease are manifold and various, and can never be resolved into exclusive hypotheses, such as the drinking-water hypothesis, the ground hypothesis, etc.

It follows, therefore, that it is not by sanitary improvements in one direction only that we can control the spread of preventable epidemic diseases. In one situation improvements in the supply of drinking-water check the prevalence of typhoid-fever, in another place similar measures show no such influence; or, again, in one city the introduction of a good system of sewerage diminishes epidemic diseases, and in another no similar result follows. We should therefore aim to secure, as far as possible, good sanitary arrangements in all directions and in all respects.

It has also been rendered evident, in what has been said, that infectious agents differ markedly from each other in their behavior; so that, while public sanitation aims at those measures which are found to be most widely beneficial, it should not forget that each infectious disease is as much a separate problem in its prophylaxis as in its symptomatology, etiology, and treatment. It will not aim to combat cholera with the means found best adapted to scarlet-fever, but it will adapt preventive measures as directly to the specific end in view as possible. In presenting to you the results of researches chiefly bacteriological concerning the scientific basis of preventive medicine, I hope to escape the accusation of one-sidedness and narrowness by the statement that I do not for a moment intend to imply that the bacteriological method is our only source of accurate knowledge on the subjects which have been considered. My aim is accomplished if I have succeeded in making clear that this method has established facts which aid in a clearer conception of the causes of some important infectious diseases, in a better understanding of the sources and dangers of infection, and in a more efficient selection and application of sanitary measures.

If this science of only a few years' growth has furnished already acquisitions to knowledge so important, so far reaching, may we not look forward with assurance to the solution of many dark problems in the domain of infectious diseases, — problems the solution of which may yield to preventive medicine a future of usefulness and success which we cannot now foresee?

LUCERNE OR ALFALFA.

DURING the past two years considerable has been written concerning the value of alfalfa as a forage-plant and for hay. Experiments in a limited way have been made at the Agricultural Station at Geneva, N.Y., of which Mr. Peter Collier is the director, since 1882.

Alfalfa or lucerne is botanically the same plant (*Medicago sativa*, Lin.), and one of the clover or leguminous family. Alfalfa has been grown in Greece for nearly three thousand years as a forage-plant. The Romans esteemed it very highly, and Columella writes that it yielded four to six crops a year. In France the plant is known as lucerne, and in Spain as alfalfa. It is grown quite extensively in southern Europe. From Spain alfalfa was introduced into South America, and thence by way of Mexico to California, where it still retains the Spanish name, alfalfa. While in California and many of the Western and Southern States it is grown quite extensively, it has never been much cultivated in the Northern States. In the Eastern States it was introduced from Europe, and is generally known as lucerne. The alfalfa from California is said to withstand drought far better than the lucerne of Europe, while the lucerne withstands cold winters better than the alfalfa.

It seems to be the prevalent opinion that lucerne does not flourish well so far north as New York State, but seven years' experience with it at the Geneva station proves that it can and will thrive well in this latitude. Chancellor Livingstone experimented with it with good results on his estate in Columbia County nearly ninety years ago. It has been generally conceded, that, in order to succeed, lucerne must have a deep, sandy, or light loam soil. The experience of the station has been upon heavy clay loam, some of it of a cold retentive nature. This indicates that alfalfa will thrive well upon other than sandy or light loamy soils. Two acres and a half of lucerne now growing at the station, on three parts of the farm, show well the capabilities of the plant to withstand the drought and northern winters. In 1882 two plats were put down to lucerne and alfalfa. These plats have yielded several crops each season since. In 1888 they were cut three times, and yielded an average

of about fifteen tons per acre of green fodder, after having been down to grass from the original seeding six years.

From the analysis of alfalfa for different years as grown at the station, at the period of full bloom it was found to contain 67.46 per cent of water. With the figures of the analysis as the basis, it is found, that if the fifteen tons of green fodder, having a composition like the above, were converted into hay, they would be equal to 5.6 tons of hay per acre. The chemical composition of this hay is shown by analysis to be much like red-clover hay, and to contain nearly as much albuminoids as does wheat-bran. The total amount of fertilizing matter removed from one acre by the crop for the year was very large. Especially is this true of the nitrogen, potash, and lime. Alfalfa is pre-eminently a lime-loving plant, and it is generally recommended to apply a good dressing of lime to the soil before putting down to alfalfa.

In a feeding trial made at the station during the past winter, the digestibility of alfalfa hay was determined. The subject for experimentation was a four-year-old Jersey cow, in milk about two months when the trial was made. Feb. 23 the feeding of alfalfa hay was begun. Twenty-five pounds per day were offered, and, during the five days on which the dung was saved, an average of 24.31 pounds, or 389 ounces, per day were eaten. The amount of dry matter consumed per day was 322.7 ounces.

By comparison of the results with those for the digestibility of clover hay as found by Armsby, it is found that alfalfa is considerably more digestible than red clover. Especially is this true for the albuminoids and nitrogen-free extract.

Some notes from station experience, on the method of preparing the soil for planting out lucerne-seed and for curing the hay, may be of interest to those who contemplate making a trial of this crop.

Perhaps the best time to sow alfalfa is in the spring. The earliness will depend on the condition of the soil, moisture, and warmth. A crop that is to hold the ground, so long as we expect alfalfa to produce profitably, should have a faultless seed-bed prepared for it to start on. This is especially desirable where the first year's growth may be expected to be small, and may be overcome by weeds if any exist with it, and care is not taken to reduce them to a minimum. It would be well to specially prepare a suitable piece of land with a late summer fallow, or some crop which can be kept hoed free from weeds. Then, when the land is in good condition to work in spring, make a nice bed, and, if there is likelihood of many weeds starting on it, wait a week for them to germinate, harrow up well, and at once sow the alfalfa-seed if it is to be broadcasted. If it is to be drilled and cultivated the first season, the harrowing before seeding may be omitted. Roll the soil with a moderately heavy roller after sowing the seed. This will compact the soil about the seed, and hasten germination.

Having the crop started, one has only to watch the growth, and, if vigorous enough, it may be cut the first season. If allowed to stand too long, alfalfa becomes hard and woody in the stalk : hence a part will be wasted. It will also draw too largely from the roots for the good of the succeeding crops : so it seems best to cut it during the first period of good weather after the blossoms begin to appear. If designed for soiling, it should be wilted before feeding, to be sure that animals will not eat enough to cause hoven. This can be done by cutting feed one day ahead in fair weather, or longer if there is an appearance of storm.

If designed for hay, it must be very carefully handled, for like all the clovers, and to a greater extent perhaps, its leaves will drop off during the curing and housing, and leave only a mass of bare stalks instead of the bright green leaves and blue blossoms which ought to stay on for the best hay.

A good time to mow is in the afternoon, so it will wilt but not dry much before night. The next forenoon or toward evening, after the leaves become tough, pitch together into small cocks from the machine-swath.

Two active men can pitch from three to five swaths together quite fast, and, if wide barley-straw forks are used, there will be little use for a rake. After the cocks are made, they should stand two or three days before pitching over ; then put two or three into one, if making well, and observe to turn every forkful bottom up, and spread out the thick green bunches so they will be brought into contact with the dry portions. All the work of pitching, from the first to the final mowing away, must be done when the alfalfa is tough, but not wet from dew in the morning or evening. Never handle clover when it rattles, for the leaves will be broken and wasted. A second or third handling will be needed before the hay will be fit to store. The drawing should be done early in the forenoon ; and, if the bottom layers of hay are wet, the cocks can be overturned from the sun, and, after a few minutes' exposure, will be dry enough to load. Alfalfa or other clover hay made in this way comes out fresh and bright, and retains its leaves and flowers to an extent beyond the belief of those who are accustomed to rake clover with a horse, open out the hay to the sun, and pitch it in the heat of the day. The value saved will be worth all the extra time, if any is required.

The result of the station experience with lucerne or alfalfa may be summarized as follows : 1. That lucerne or alfalfa may be successfully grown in New York State ; 2. That when once established, it thrives well upon clay land, but will probably do better upon good light loam ; 3. That seed two years old loses its vitality, and fails to germinate (undoubtedly many of the failures to secure a stand of plants may be traced to poor seed) ; 4. That the seed-bed must be well prepared, and in this latitude it seems best to plant out the seed in the spring, and with no other crop (the seed should be but lightly covered by rolling the ground) ; 5. That for seven successive years at the station three and four cuttings per year have been taken from the plats ; 6. That last year, the sixth in succession, the plats yielded more than fifteen tons per acre of green forage, equal to 5.6 tons of alfalfa hay ; 7. That alfalfa should be cut in early bloom, before the plants become woody ; 8. That it should be cured largely in the cock to produce the best quality of hay ; 9. That by chemical analysis the hay was found to be more nitrogenous than good red clover ; 10. That cattle, sheep, and horses all relished the hay, and seemed to do well ; 11. That it was found to be more digestible than red-clover hay ; 12. That if farmers would try this crop, it is advisable to begin with a small piece of well-prepared land, in order to see whether alfalfa does as well with them as it has at the station ; 13. That probably success with alfalfa will depend largely upon having fresh seed, a good, carefully prepared seed-bed, and in covering the seed lightly with soil.

HEALTH MATTERS.

PNEUMONIA. — Drs. C. W. Townsend and A. Coolidge, jun., of Boston, from a study, published in *The Medical News*, of all the cases of lobar pneumonia treated at the Massachusetts General Hospital, from the first case, in 1822, up to the present day, find that (1) in the thousand cases of this disease treated between those dates there was a mortality of 25 per cent ; (2) the mortality has gradually increased from 10 per cent in the first decade, to 28 per cent in the present decade ; (3) this increase is deceptive for the following reasons, all of which were shown to be a cause of a large mortality, — (*a*) the average age of the patients has been increasing from the first to the last decade, (*b*) the relative number of complicated and delicate cases has increased, (*c*) the relative number of intemperate cases has increased, (*d*) the relative number of foreigners has increased ; (4) these causes are sufficient to explain the entire rise in the mortality ; (5) treatment which was heroic before 1850, transitional between 1850 and 1860, and expectant and sustaining since 1860, has not, therefore, influenced the mortality rate ; (6) treatment has not influenced the duration of the disease or of its convalescence. It must, however, be admitted that the present treatment of expectancy — a treatment which makes the patient as comfortable as possible, preserves his strength, and avoids every thing harsh — is certainly far more agreeable to the patient than the former heroic method. After these studies, we cannot but admire the regular and uniform manner in which pneumonia — that type of self-limited diseases — has run its course in all these years, uninfluenced by the varying treatment it has received.

DR. BROWN-SEQUARD'S HYPODERMIC FLUID. — The extraordinary statements made by Professor Brown-Séquard as to the efficiency of hypodermic injections of fluid expressed from certain tissues of young animals in senile debility have been to a certain

extent confirmed by M. Variot, who made a communication to the Société de Biologie on June 29. The patients chosen were debilitated men, aged fifty-four, fifty-six, and sixty-eight years respectively, and they were not informed of the nature of the treatment adopted. In all three cases the injections were followed by general nervous excitement, increased muscular power, and stimulation and regulation of digestion. M. Brown-Séquard said that M. Variot's observations disposed of the objection that the results he had observed in himself were due to "suggestion."

THE HEREDITY OF MYOPIA. — If the opinions of various ophthalmologists concerning the heredity of myopia were recorded here, the result would be an accumulation of vastly conflicting statements. This, however, would be largely due to lack of precision in investigating the subject. Lately Dr. Motais has carefully studied both the history and course of disease in 330 cases of myopia occurring in young people, and has arrived at the following conclusions, which are given in *The Medical News*: 1. The hereditary influence of myopia is manifest; 2. Out of 330 cases, the families of 219 were afflicted with the same disease (this shows a percentage of 65 per cent); 3. Hereditary myopia is distinguished from acquired myopia by (*a*) its more early appearance, (*b*) its more rapid development, (*c*) its greater severity, (*d*) its being more frequently followed by other complications (in short, hereditary myopia is far more serious than the acquired form of the disease); 4. Myopia is usually transmitted from the father to the daughter (86 per cent), and from the mother to the son (79 per cent); 5. The principal conditions which favor the transmission of hereditary myopia are, (*a*) use of the eyesight under bad hygienic surroundings (whether in school or at home), (*b*) Astigmatism (14 per cent), (*c*) Microsæmia (diminution of the orbital arch), 16 per cent; 6. The increase of the disease in hereditary cases was, in 6 per cent of the cases, found to be mainly the fault of those who had charge of the child's education. If care is not taken, acquired myopia will not restrict itself to the individual, but may also be transmitted unto their children.

ELECTRICAL NEWS.

WIRING OF SHIPS. — In order to avoid any disturbance of the magnetism of the compass of a vessel by the powerful currents used in electric lighting, Sir William Thomson recommends the exclusive employment of a two-wire system, the positive and negative mains being not far apart save in those cases, of rare occurrence at present, in which alternating currents are employed. A galvanometer of simple construction should also be made use of, for the purpose of ascertaining that the outgoing and return currents are of the same strength, or, in other words, that no leakage is occurring. Further, the magnetic leakage from the dynamo should not be sufficient to cause any appreciable disturbance of the compass-needle, which may be tested by observing this needle at the moments of starting and stopping the dynamo. In opposition to Sir William, says *Engineering*, Mr. Alexander Siemens, whose firm have fitted up a large number of vessels with the electric light, has not found any special precautions necessary, the single-wire system being employed in every case. As for the dynamo, he has never found any disturbance from this cause, provided that there was a distance of fifty feet between the dynamo and the binnacle.

BOOK-REVIEWS.

Autobiography of Friedrich Froebel. Tr. by EMILIE MICHAELIS and H. KEATLEY MOORE. Syracuse, C. W. Bardeen. 12°. $1.50.

THE bulk of this volume consists of a letter from Froebel to the Duke of Meiningen, to which is added an extract from another of his letters, and several notes by the translators. The letter to the duke relates to the early part of the author's life, from his birth to the establishment of his school at Keilhau, where his system of education, since known as the kindergarten system, was first definitely carried into practice. The letter to the duke of Meiningen is unfinished, and whether it was ever delivered to the duke at all is uncertain. But, however that may be, the letter gives a full account, not only of the writer's early life and education, but also of his theory of education in general. His practical method, unfortunately, receives but scant mention; and, if we had no other sources of information than this book contains, we should be at a loss to know what his improvements in education really were. His theories however, and the pantheistic philosophy on which they are based, are expounded superabundantly, page after page being filled with what is little better than vapor. He is forever talking about the "unity and inner connection" of things, "the inner law and order embracing all things." Whenever he studied any subject, he always sought for this "inner connection," and he complains of Pestalozzi's school, which he visited, as lacking in inner harmony and unity. Precisely what he meant by these phrases it is sometimes difficult to ascertain; but they are repeated till the reader is weary of them. He had, as even his translators admit, an absurdly exaggerated sense of the importance of his educational methods. He seems to have thought that the wisdom of ages and the accumulated experience of mankind were worthless, and declared that he wanted "the exact opposite of what now serves as educational method and as teaching-system in general." Indeed, he seems to have thought that he was going to revolutionize the culture and life of humanity, whereas all he has accomplished is some slight improvements in the education of children. Of his ardent devotion and spirit of sacrifice for the good of others, this book bears abundant evidence. He was often in pecuniary difficulties, yet, amid them all, he steadfastly pursued his course after he had once learned his true vocation as an educator. It is to be regretted that the translators have not given a fuller account of Froebel's more elaborate experiments in teaching, to which he really owes his influence and fame, and which are scarcely touched upon in his autobiographical letter. As it is, we get from this book an interesting account of his early life, and of his theories and aspirations, but very little information as to the inception and introduction of those practical methods in which his real life-work consisted. However, we must be thankful to the translators for giving us the autobiography in English, and, as they themselves remark, wait till some adequate biography appears for the fuller information we desire.

AMONG THE PUBLISHERS.

"THE Life of Harriet Beecher Stowe," by her son, Rev. Charles E. Stowe, is now passing through the Riverside Press, and will be given to the public early in the autumn. It will be a book of peculiar personal and literary interest, and will appeal to a host of readers on both sides of the Atlantic. It is to be a handsome volume, embellished with fine portraits and other illustrations, and will be sold by Houghton, Mifflin, & Co. by subscriptions.

— Messrs. Ginn & Co. announce for publication in August "Myers's General History," by P. V. N. Myers, president of Belmont College. This book is based upon the author's "Ancient History" and "Mediæval and Modern History," and is characterized by the same qualities as mark the earlier works. It is believed that the difficult task which the author set for himself, of compressing the fourteen hundred or more pages comprising the two text-books mentioned into a single volume of about seven hundred pages, has been accomplished without impairment either of the interest or of the easy flow of the narration. The greatest care has been taken to verify every statement, and to give the latest results of discovery and criticism. The book is provided with between twenty and thirty colored maps, besides nearly two hundred sketch-maps, woodcuts, and photogravures. The illustrations have been drawn from the most authentic sources, and nothing has been admitted save what is illustrative and truthful.

— Sampson Low & Co. have published a work entitled "Englishmen in the French Revolution," by Mr. J. G. Alger, which is based upon much personal research among unpublished documents both at the Record Office and in Paris. Besides incorporating two articles that originally appeared in the *Edinburgh Review*, dealing with the early days of the Revolution and the Terror, chapters are added about the prisoners of war, the opening of Paris by the peace of Amiens, and the subsequent imprisonment

of visitors in France by Napoleon. Attention has been given not only to spectators, deputations, and victims, but also to those writers who sympathized with the downfall of the *ancien régime*.

— Dr. Nansen, the Arctic explorer, has made arrangements with Longmans, Green, & Co. for the publication of an account of his recent Greenland expedition. The book will be ready early next spring, and will be illustrated with maps and plates.

— Kegan Paul, Trench, & Co. will shortly publish the first number of a new serial devoted to the reproduction of selected works of the foremost photographers of the day. It is proposed to issue quarterly a portfolio of four photogravure pictures from the negatives of "Sun Artists," such as will tend to advance photography in the estimation of the art-loving public, and obtain for it the position which it now claims. The first number of "Sun Artists" will consist of four studies by Mr. J. Gale, on imperial quarto paper, with letterpress.

— Funk & Wagnalls have just issued a practical little book, entitled "Emergency Notes," in which Dr. Glentworth R. Butler tells in a clear, easily understood way what to do in the emergencies that are ever arising in this world of multiplied diseases and accidents.

— A. C. Armstrong & Son have, by arrangements with Rev. C. H. Spurgeon and his English publisher, issued the first volume of his new work entitled "The Salt Cellars," being proverbs and quaint sayings, together with homely notes thereon. It is alphabetical in arrangement, and brings the proverbs down to the letter M.

— D. Appleton & Co. will publish immediately "Christianity and Agnosticism," a controversy consisting of the papers by Henry Wace, Professor Huxley, W. H. Mallock, the Bishop of Peterborough, and Mrs. Humphry Ward, which have been appearing in different periodicals, and which many persons desiring to get at the complete discussion will be glad to have in one volume.

— George O. Seilhamer, 112 North 12th Street, Philadelphia, has nearly ready the second volume of his "History of the American Theatre," treating of the period during the Revolution and after. The last volume, which is in preparation, will treat the subject in the "Last Years of the Eighteenth Century."

— Little, Brown, & Co. have in preparation "Myth and Folk-Lore of Ireland," by Jeremiah Curtin, an original and fresh contribution to the already rich store of the folk-lore of the "Emerald Isle," extracted by the author from Gaelic sources.

— Messrs. Ginn & Co. announce for publication about Oct. 1, "History of the Roman People," by Professor W. F. Allen of the University of Wisconsin. This will replace the second part of Myers's "Outlines of Ancient History." This sketch of Roman history will place especial emphasis upon two series of events, — first, the policy and process by which the Roman Dominion was secured and organized during the republic, its re-organization under the empire, and final disruption at the time of the German migrations; second, the social and economical causes of the failure of self-government among the Romans, and the working of the same forces under the empire (in this point of view, the history of religion among the Romans will be carefully traced).

— Hereafter the *American Journal of Psychology* will be published from Clark University, Worcester, instead of from Johns Hopkins University, Baltimore. Remittances and business communications should be addressed to the clerk of Clark University, Worcester, Mass., and scientific and editorial communications to G. Stanley Hall, editor, Clark University, Worcester, Mass.

— G. P. Putnam's Sons announce among their first autumn publications, "The Industrial Progress of the Nation, Consumption Limited, Production Unlimited," by Edward Atkinson, author of "The Distribution of Products," etc.; "A Race with the Sun," a sixteen-months' trip around the world, by Hon. Carter H. Harrison of Chicago, illustrated by many full-page plates; "The Modern Chess Instructor," by W. Steinitz; "Christian Theism, its Claims and Sanctions," by D. B. Purinton, LL.D., vice-president of West Virginia University, and professor of metaphysics; "To the Lions," by Alfred Church; "A Woman's War Record, 1861-1865," by Mrs. Gen. Charles H. T. Collis; "Lectures on Russian Literature," by Ivan Panin; "The Practical Pocket Dictionary in Four Languages, — English, French, German, and Italian;" and "Tales from the Korea," collected and translated by Henry N. Allen, secretary of the Korean Legation. In the Story of the Nations Series they will publish "The Story of the Hansa Towns," by Helen Zimmern; and in the Knickerbocker Nuggets, "Sesame and Lilies," by John Ruskin; "The Autobiography of Benjamin Franklin;" "Tales by Heinrich Zschokke;" and "Great Words from Great Americans," the last comprising the Declaration of Independence, the Constitution of the United States, Washington's Inaugural Addresses, Lincoln's Inaugural Addresses, Lincoln's Gettysburg Address.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

A Circular Note to Working Entomologists.

MOSQUITOES and house-flies are perhaps the most numerous, widely distributed, and persistent of the creatures that attack the health and comfort of human beings. Of their attacks upon our comfort every one is aware. Scientific investigation favors the belief that tuberculosis and ophthalmia are carried from diseased persons to healthy ones by the house-fly, and German experimenters have shown that serious blood maladies may be transmitted by the mosquito.

Certainly, therefore, any suggestion, however remote, of a means of decreasing the numbers of or exterminating these pests, should be followed with all possible skill and patience.

I have observed dragon-flies gathering in scores around my camp in Minnesota to feed on the mosquitoes. I recently saw a dragon-fly that had devoured over thirty house-flies still voracious for more. Entomologists have observed the larvæ of the dragon-fly swallowing undeveloped mosquitoes in large numbers.

Now, may we not have in the active, voracious, harmless "mosquito-hawk," an agency for greatly diminishing the numbers of the smaller insects?

Professor Baird's success in producing millions of healthy fish in a few laboratory boxes and jars, the propagation of silkworms by scores of millions from eggs carried half around the world to Italy, the success of the plan for breeding foreign humble-bees in Australasia to fertilize the red clover, — these and many other similar facts seem to show that scientific methods have reached a stage where it is reasonable to hope that a plan may be devised whereby whole tribes of noxious insects may be exterminated by the artificial multiplication of their innoxious enemies.

Not being an entomologist, I have consulted with several distinguished students of that science as to the best means of reaching some practical result in the direction above indicated, and they agree with me that the following preliminary step may be usefully taken: —

For the purpose of drawing the attention of entomologists to the subject mentioned, I have placed in the hands of Morris K. Jesup, Esq., president of the American Museum of Natural History, New York City, $200, to be paid by him in three prizes of $150, $30, and $20, for the three best essays, based on original observations and experiments, on the destruction of mosquitoes and flies by other insects.

The following suggestions are made as to the direction in which the investigation should be carried and the essay formulated: 1. Observations and experiments upon various insects that destroy mosquitoes and house-flies, stating the method of and capacity of destruction; 2. Observations and experiments to determine the best dragon-flies to be artificially multiplied for the two above-named objects, — probably species of *Æschna*, *Libellula*, or *Di-*

plax; 3. Give detailed statements of the habits and life-history of the species chosen, based on original and careful experiments and observations; 4. Suggest a plan for breeding the insects in large numbers, with a sketch of apparatus, and estimated cost of producing them per thousand; 5. Formulate a plan for using the insects in the larva, pupa, or perfect state for the destruction of mosquitoes and flies, (*a*) in houses, (*b*) in cities, (*c*) in neighborhoods.

The prizes will be awarded after careful consideration by Dr. Henry C. McCook, vice-president of the Academy of Natural Science of Philadelphia, and vice-president of the American Society of Entomologists, and Dr. J. S. Newberry, president of the New York Academy of Sciences, professor of geology of Columbia College, and late chief of the Geological Survey of Ohio.

In awarding the prizes, clearness of statement obtained by accompanying sketches, and new and purely scientific facts in the life-history of the *Libellulidæ*, of which so little is known, will be duly considered.

All the essays received may be published wholly or in part, at the discretion of the judges, and full credit will in all cases be given to each observer.

The essays should be forwarded by Dec. 1, 1889, to Mr. J. H. Winser, at the American Museum of Natural History, 77th Street and 8th Avenue, New York, to whom all communications should be addressed. ROBERT H. LAMBORN.

32 Nassau Street, New York, July 15.

Are Beech-Trees ever struck by Lightning?

REFERRING to note on p. 7 of *Science* for July 5, and letter on p. 50, July 19, I here record some observations on the same subject. During a prolonged summer drought, about one o'clock P.M., the sun was shining brightly, but a small cloud came from the south-east; and while two other gentlemen and I were seated in my parlor, conversing, a flash was seen, and a sharp explosion heard. In a few moments a man came in, announcing that he had been thrown from the wagon, the driver knocked down, also five of the six oxen, "three of which were killed by lightning." Hastening to the spot, about two hundred feet from the parlor, we found the wagon under the branches of a large beech-tree a few feet from the trunk, the wheels in contact with roots, the fore-wheels having passed the trunk; the oxen all recovered and standing, save the farthest one from the tree. He was dead, and never moved a muscle. The messenger was seated on the hinder part of the wagon when struck and knocked down. The driver walking on the opposite side of the tree, perhaps ten feet from the trunk, but some of the spreading branches almost touching his head, was knocked down, somewhat stunned, and, although standing on our arrival, had not fully regained his wits, nor his hat.

The tree was tall, and thickly branched to the top. On careful and minute examination, we found no mark of electricity on trunk, root, or branch; but later we discovered, perhaps twelve or more feet from the top, a space about three inches wide and six or eight feet long, as we guessed, from which the bark was torn and the wood grooved. Some days later we discovered that a strip of bark extending from the rent above mentioned to the earth was dead and peeling off, and the wood grooved. Our conclusion was that the electricity mostly passed between the bark and the wood, there being most moisture at plane of contact. Not a drop of rain fell during the day, nor during many weeks before and after the above incidents.

This is by no means the only instance in which I have known the beech-tree struck by lightning, nor the only one in which the electricity seemed, at least, to pass between bark and wood of beech, oak, tulip-tree, black gum, *Magnolia grandiflora*, etc.

Why was neither man killed in this instance, and only the ox farthest from the stricken tree? The explanation is simple enough. Here was a ridge gently sloping to the east, west, and south. The stricken tree was perhaps twenty feet from the lowest western level. One ox had placed one foot on the lowest spot of ground which it is presumed was near moisture beneath (the rest of the land being dried, and on the crest of the ridge to such a depth as to cause the death of several trees): the circle from moist earth through the ox, the chains, and iron of the wagon, was completed to the tree. One of the two oxen nearest the tree did not fall. All the phenomena caused me to think that the discharge was *from* the earth.

Having had many extraordinary, very undesirable, and extremely dangerous opportunities of witnessing phenomena of natural electricity, other facts may possibly be given later. D. L. PHARES.

Madison Station, Miss., July 24.

Breathing.

MY attention has recently been called to your editorial comments on my observations made on the chest-movements of some eighty Indian females about two years ago, from which I felt justified in concluding that the abdominal was the original type of respiration in woman, and that the costal type has been acquired through the influence of abdominal constriction. Now, although this observation and conclusion was confirmed more recently by the experiments of Dr. Kellogg, who measured the chest-movements of a number of Chinese women in the Far West whose abdomens were never constricted by artificial appliances, you incline to the belief that "the question of what is the natural type of respiration may still be regarded as *sub judice*, unless (which perhaps may be the truth) both types are natural under varying conditions independent of dress," because "other observers, notably Hutchinson in his examination of twenty-four girls whose waists had never been constricted by corsets or other appliances, found the costal type present."

With the highest regard for your opinion, I beg to say that such a deduction is scarcely allowable from the premises of my researches. These show, in all probability, that Dr. Hutchinson's girls were not entirely free from the influence of abdominal constriction, even though they never wore corsets: for in the Indian the abdominal type obtains the highest form of development in the full-blooded girl, whose body, as well as the bodies of her ancestors, has never been subjected to the influence of abdominal constriction; and this type seems to disappear from the Indian girl in the proportion of the admixture of white blood in her veins. It is very probable, therefore, that heredity is an important factor in the maintenance of women's breathing; and any experiment or deduction which fails to give this due consideration will naturally lead to final disappointment.

So far as I know, Dr. Kellogg's and my own experiments are the only efforts which have been made to solve this problem by studying the respiratory movements in their most primitive condition in woman, and, until they are disproved by experiments based on identical conditions, I think they must be taken as conclusive. THOS. J. MAYS.

Philadelphia, July 29.

Exchanges.

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Lead, zinc, mundic, and calcite. — Lulu Hay, secretary Chapter 350, Carthage, Mo.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for $2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 × 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4″ × 5″), for fine geological or mineralogical specimens, properly classified. — Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc. — Alda M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition. — Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

California onyx, for minerals and coins not in my collection. — W. C. Thompson, 612 East 141st Street, New York, N.Y.

Will such members of the Agassiz Association as botanize this summer, and can afford time, please observe for me any case of doubling in any flower and in any locality, stating name of flower (Gray), the abnormal change, the time and place found, and whether monstrosity is abundant or otherwise? Please address communications to Will G. Cole, 3643 Prairie Avenue, Chicago, Ill.

Any one who has a botanical box in good condition will please write. I will offer about [illegible] specimens in exchange. — C. B. Haskell, Box 826, Kennebunk, Me.

A few first-class mounted birds, for first-class birds' eggs of any kind in sets. — J. P. Babbitt, secretary Chapter 755, 10 Hodges Avenue, Taunton, Mass.